RSI TOW CONVEYOR

PREVENTIVE MAINTENANCE & TROUBLE SHOOTING MANUAL

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RSI TOW CONVEYOR SYSTEM

1. INTRODUCTION

This manual has been designed to help you achieve many years of trouble free low maintenance production from your RSI Tow Conveyor System. Only the finest material and components have been chosen in the manufacturing of this system and we here at RSI, Inc. recommend that only the finest lubricants and RSI, Inc. approved maintenance procedures be used in the systems regular scheduled maintenance program. We feel confident that if these procedures are followed you will receive many years of trouble free service from your system.

A. SYSTEM SUMMARY

The RSI Tow Conveyor System has been designed to adapt to most of your manufacturing needs, from furniture manufacturing and finishing to marine and automotive engines to almost anything produced on the factory assembly line.

The versatility of the Tow Conveyor is achieved by the use of a special tow chain which allows the carts to be placed on practically any center distance you choose. This combined with adjustable speed ranging from 8 FPM to 12 FPM allow for the right amount of time for each operation to be completed properly, and not the hurry-up, here-comes-the-next-part method that can cause costly mistakes and poor overall quality. These features are incorporated with cart delays which can be placed in work stations, spray booths, drying ovens or practically anywhere on the system as required by your particular needs.

2. **START - UP PROCEDURE** (AFTER MAIN SHUT DOWN)

A. Visually inspect entire length of conveyor to ensure there are no objects in or on top of chain or track.
B. Visually inspect all cart delays to ensure all stops are in position.*
C. Visually inspect drive unit for objects in or around the drive gears and check Tow Chain for slack.
D. Fill automatic oiler if necessary.
E. All workstations should be attended.
F. Turn on main power switch.

WARNING: Carts should be in proper rotation for manufacturing sequence.

WARNING: Before performing maintenance, air & electricial should be turned off unless specified elsewhere in this manual.

3. **PREVENTIVE MAINTENANCE**

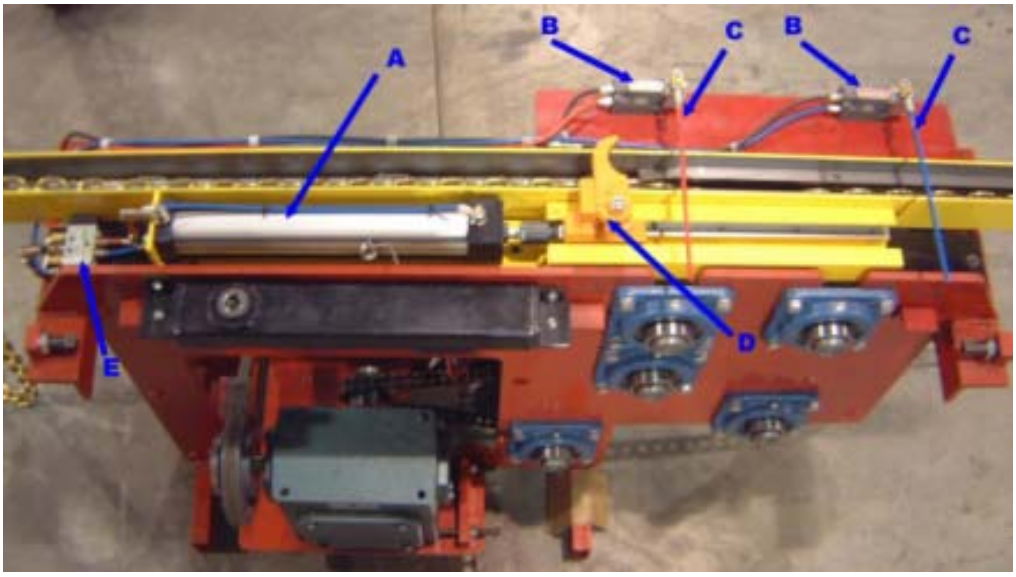
A. MOTOR:

The Reliance 2 hp/3 ph explosion proof A.C. motor is a sealed self-lubricating unit, keep unit clean at cooling fins and fan to allow motor to obtain adequate ventilation.

B. GEAR REDUCER:

Grove Gear Flex - A - Line #1425
This unit is completely adjusted and lubricated from the factory. Gearbox oil should be changed every six (6) months or 2500 operating hours. Oil change intervals should be increased to four (4) months or 1650 operating hours when total cart weight (cart & product) exceeds 1000 lbs. This interval (4/1650) should be used if the environment is dusty or excessive humidity is present.

C. PUSHER:



A: PUSHER CYLINDER
B: LIMIT SWITCHES
C: LIMIT SWITCH Wands
D: PUSHER BLOCK ASSEMBLY
E: PILOT VALVE

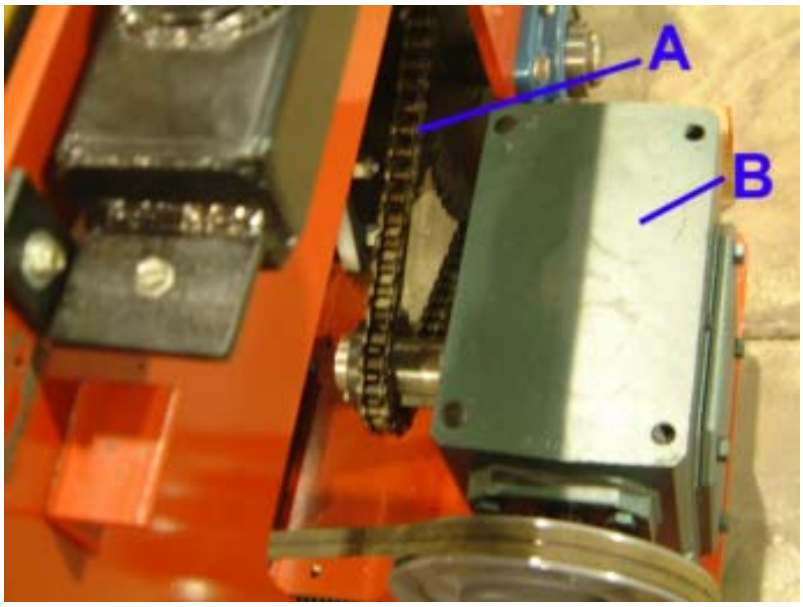
Figure # 1

Pusher should be adjusted so that a cart transfers over the dead space in the drive at the same speed as the towline chain is running. If this cannot be achieved, perform the following procedures:

1. Check airlines for foreign material
2. Check limit switch and pilot valve for foreign material.
3. Check pusher block assembly for obstacles.
4. Check and adjust flow controls as needed.

Warning: Have the air disconnected before performing this operation

D. DRIVE ROLLER CHAIN: (see Fig #2)



A: RMI 084-1017 DRIVE ROLLER CHAIN
B: RMI 531-1002 GEAR REDUCER
Figure # 2

Chain tension should be adjusted when lateral movement exceeds 1/4". To achieve proper chain tension the following steps should be followed:

WARNING: Before performing any maintenance, electricial should be turned off and disconnected.

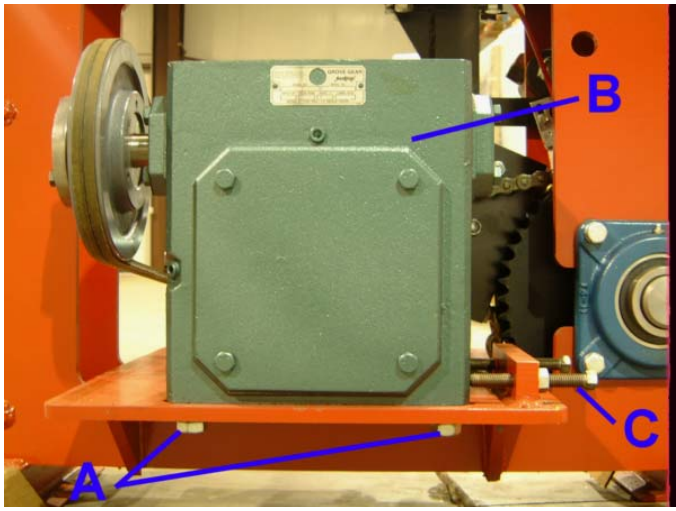
1. Loosen four (4) bolts on underside of speed reducer. (see Fig #3)

2. Loosen lock nuts on adjusting screws located on pusher side of speed reducer. (See Fig #3)

3. Turn adjustment screws clockwise to achieve proper chain tension. *

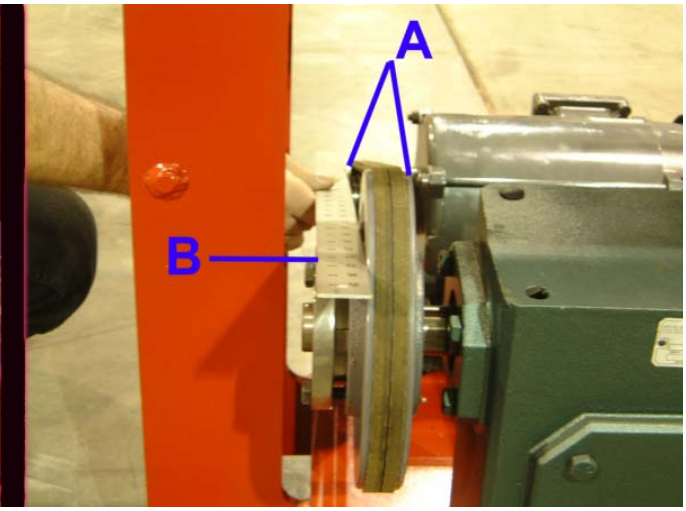
* Care should be taken to ensure adjustment screws are turned the same number of turns to keep speed reducer shaft and motor shaft parallel.

4. Once proper tension is achieved retighten lock nuts on adjustment screws then retighten bolts on underside of speed reducer.



A: MOUNTING BOLTS
B: GEAR REDUCER
C: ADJUSTING SCREWS

Figure # 3



A: SHEAVES
B: STRAIGHT EDGE

Figure # 4

5. Check V-Belt pulleys for proper alignment. If pulleys are in excess of 1/4" out of alignment adjust pulley position on motor and/or speed reducer shaft to achieve proper alignment. (See Fig #4)
   NOTE: If adjustment screws are at their Maximum mechanical allowance (approx. 3/4 movement) Drive Roller Chain must be removed and one link removed and reinstalled to achieve proper tension.

WARNING: Before performing any maintenance, electricial should be turned off and disconnected.

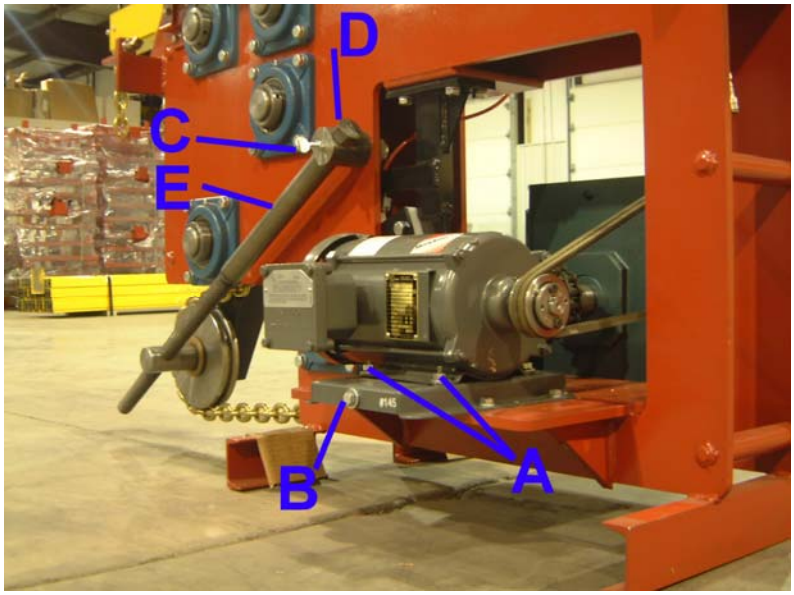
6. Lubrication of drive roller chain should be performed as follows:

   Clean environment:
   (REF. sec. 3.1-C)
   Food grade lubricants only!
   Every 150 operating hours.

   Moderate environment:
   (REF. sec. 3.1-C)
   Texas Co. Meropa oil type #1 or equal
   (Call RSI, Inc. for equals)

   Dirty environment:
   (REF. sec. 3.1-C)
   Texas Co. Meropa oil type #1 or equal
   (Call RSI, Inc. for equals)

E. DRIVE BELT: (see Fig # 4,5)



A: MOTOR MOUNTING BOLTS
B: ADJUSTMENT SCREW
C: SET SCREW
D: 1-1/4" ADJUSTING NUT
E: TAKE-UP ARM ASSEMBLY

FIGURE # 5

WARNING: Before performing any maintenance, electricial should be turned off and disconnected.

Drive belt tension should be adjusted when lateral movement exceeds 1/2". To ensure maximum life from the drive belts they should be treated every 6 mos. or 2500 operating hours with a high grade automotive belt dressing. To acquire proper belt tension the following steps should be followed.

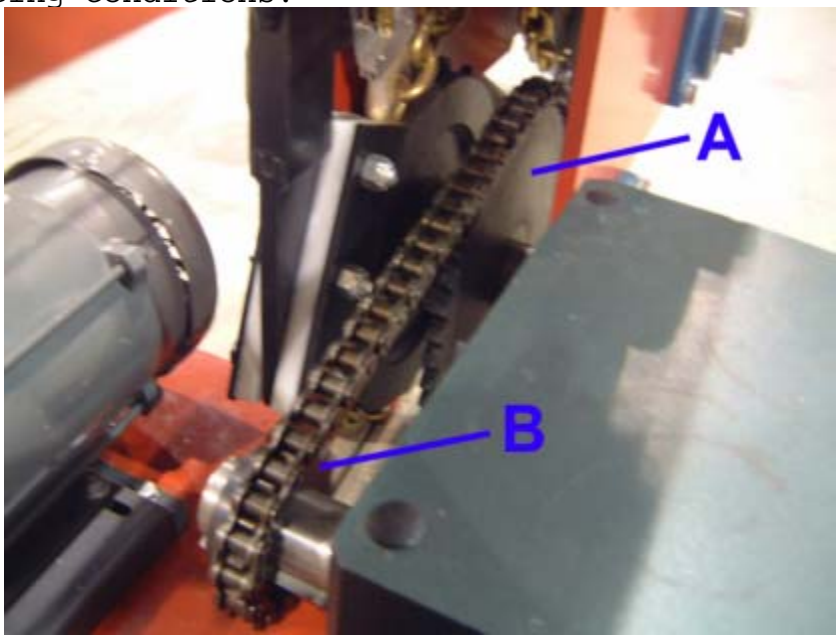
1. Loosen four (4) nuts on motor base.
2. Turn adjustment screw on motor mount clock wise until proper belt tension is acquired.
3. Retighten four (4) nuts on motor base.

F. DRIVE BELT PULLEY: (see Fig #5)

Inspect all screws for tightness every 6 mos. or 2500 operating hours. No other maintenance or lubrication will be required under normal operating conditions.

G. SPROCKETS (MAIN DRIVE): (see Fig #6)

Periodically inspect for excessive tooth wear or missing teeth. Replace if teeth are missing or showing excessive wear. No other maintenance or lubrication will be required under normal operating conditions.



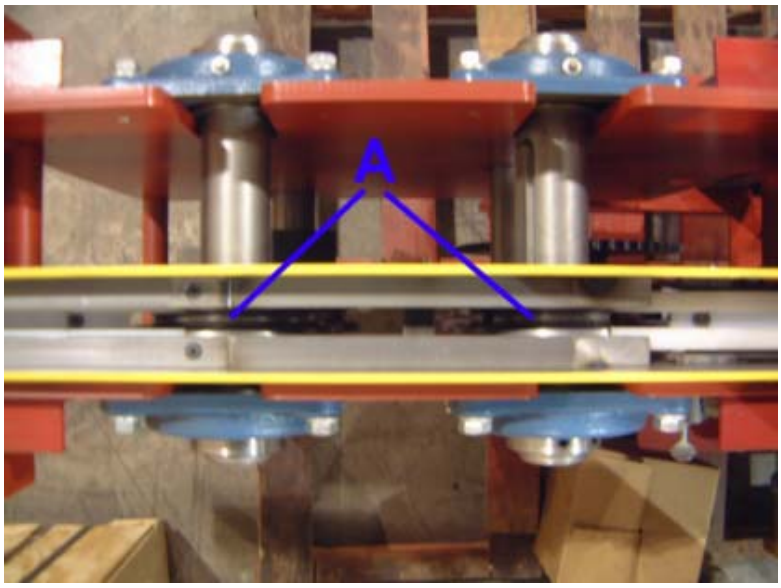
A: RMI 521-1010 PRIMARY DRIVE SPROCKET
B: RMI 521-1046 SECONDARY DRIVE SPROCKET

FIGURE # 6

H. BREAK-OVER ROLLERS {ENTRY & EXIT}: (see Fig #7)

Periodically inspect pulleys for excessive wear (mushrooming) on surface (Tow Chain Side) if excessive wear is observed replace pulley. If excessive movement on shaft (1/4" plus) is present replace roller. No other maintenance or lubrication will be required under normal operating conditions.

WARNING: Before performing any maintenance, electricial should be turned off and disconnected.

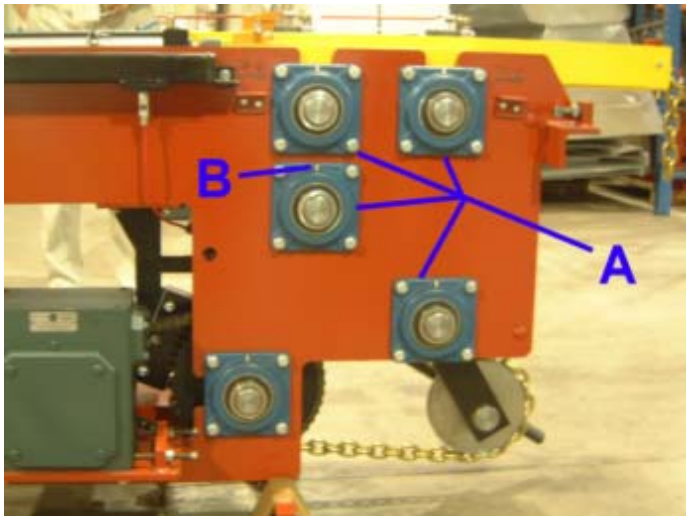


A: DRIVE BREAK OVER ROLLERS
{Entry: RMI 089-1040---hardened roller}
{Exit: RMI 089-1440---standard roller}

FIGURE # 7

I. FLANGE BEARING: (see Fig #8)

On a standard drive unit there are ten (10) flange bearings these flange bearing are sealed units and should be lubricated with Standard Oil grease or equal (Call RSI, Inc. for equals) every 150 operating hours.



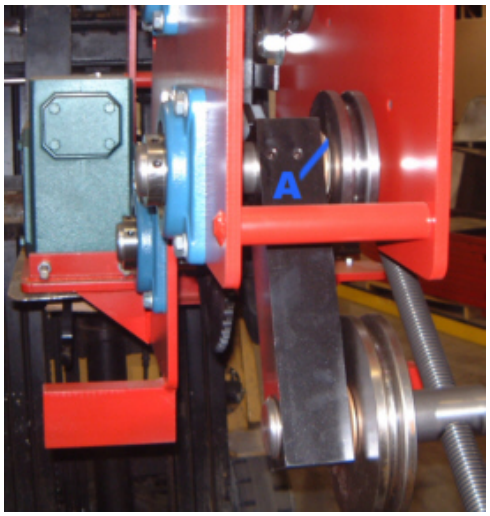
A: RMI 031-1011 FLANGE BEARINGS {10}
B: LUBRICATION POINTS

FIGURE # 8

J. IDLER PULLEY: (see Fig #9)

Periodically inspect surface (Tow Chain Side) for excessive wear (mushrooming). If excessive wear is present replace Idler Pulley. If excessive movement on shaft (1/4" plus) is present replace Garlock Bushing.

WARNING: Before performing any maintenance, electricial should be turned off and disconnected.



A: RMI-089-1041 IDLER ROLLER

FIGURE # 9

3.2 TOW CHAIN AND TRACK:

A. TOW CHAIN:

Visually inspect tow chain for proper lubrication (lack of oil excessive oil) Visually inspect Tow Chain at drive unit for proper tension.

NOTE: Tow Chain may or may not have lateral movement when drive is disengaged. When drive is engaged chain will show up to 3" of lateral movement.

WARNING: Do not work on chain while system is in motion.

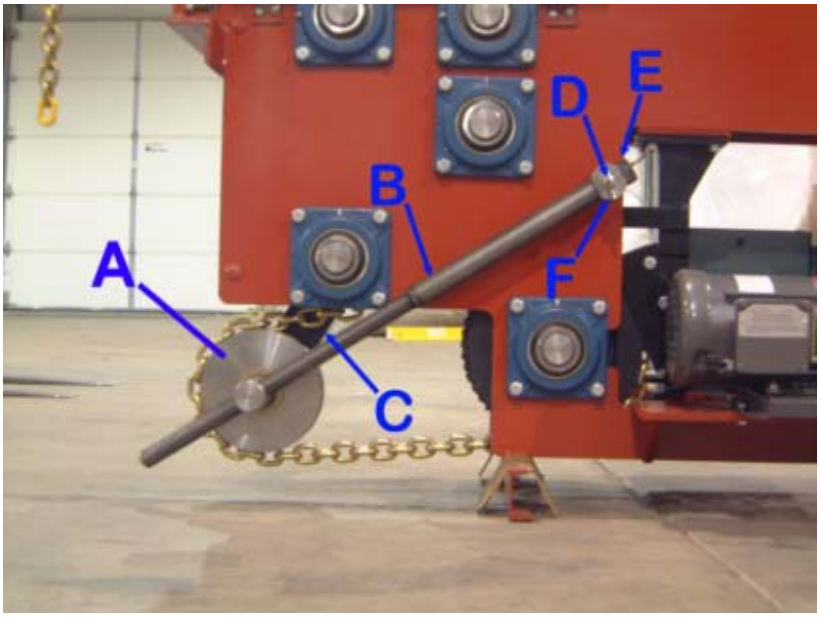
HELPFUL HINT:
If chain is to loose the system will surge (run erratically) as so if chain is too tight system will also surge. Experiment with chain tension to achieve smooth operation of your system to suit your application.

Lubrication of Tow Chain is provided by a drip oiler located in the drive unit. Keep oiler filled with SAE 30W oil. Check oil level daily.

A1. To adjust Tow Chain Tension the following steps should be followed: (see Fig #5)

1. Loosen set screw at drive end of take up rod. Turn 1-1/4" nut counter clock wise to achieve proper chain tension
   (See Helpful Hint At Sec. 3.2 A)

2. Retighten setscrew.



A: 8" TAKE-UP ROLLER
B: TAKE-UP ROD
C: TAKE-UP SWING ARM
D: SET SCREW
E: 7/8" NUT

FIGURE 10

A2. When take-up rod has been adjusted to its maximum mechanical allowances it will be necessary to remove links from the Tow chain.
To remove links from the Tow Chain the following steps should be followed:

With master link at drive unit: (see Fig #11)

1. Loosen setscrew at drive end of take-up rod. Turn 1-1/4" Nut (Fig #5) clockwise until 8" Idler Pulley is within 1" from main drive gear. (Fig #10)

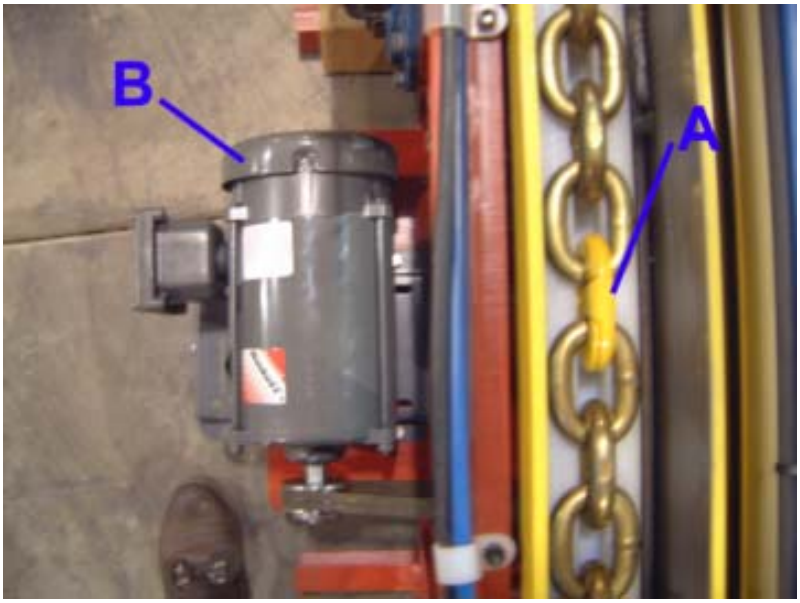
2. Manually (BY HAND) turn Drive Pulley until all tow-chain slack can be pulled up through the exit end of the drive unit. (Fig #12 & Fig #13)

3. Remove master link and overlap excess chain (See Fig #12) where overlap meets point of master link

connect, cut tow chain with bolt cutter and discard excess chain.

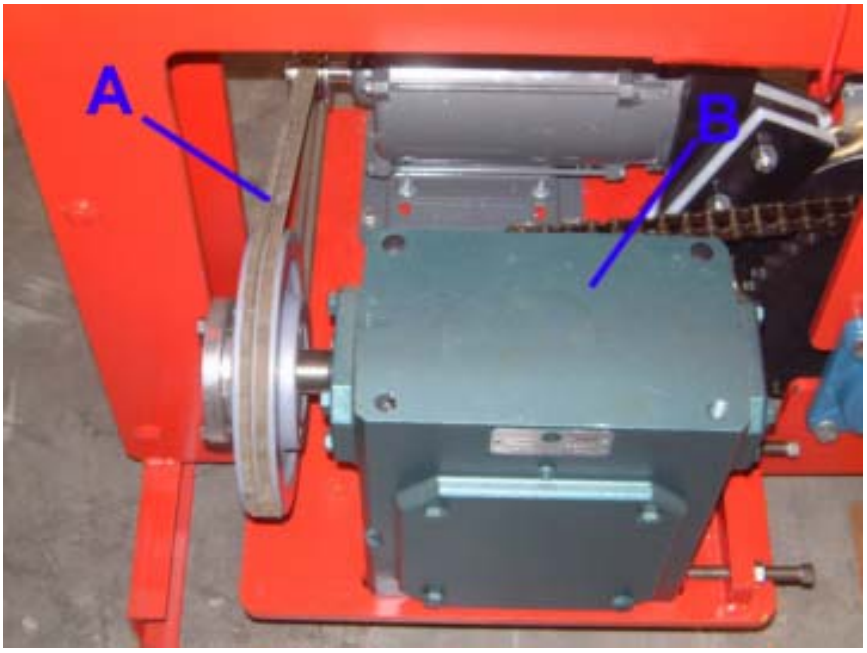
4. Reconnect Tow-Chain by replacing master link (CAUTION: Master link to be installed in the vertical position. See Fig #11) Care should be taken to assure tow-chain is not twisted.

5. Adjust tow-chain as described in Sec. 3.2 - A1.

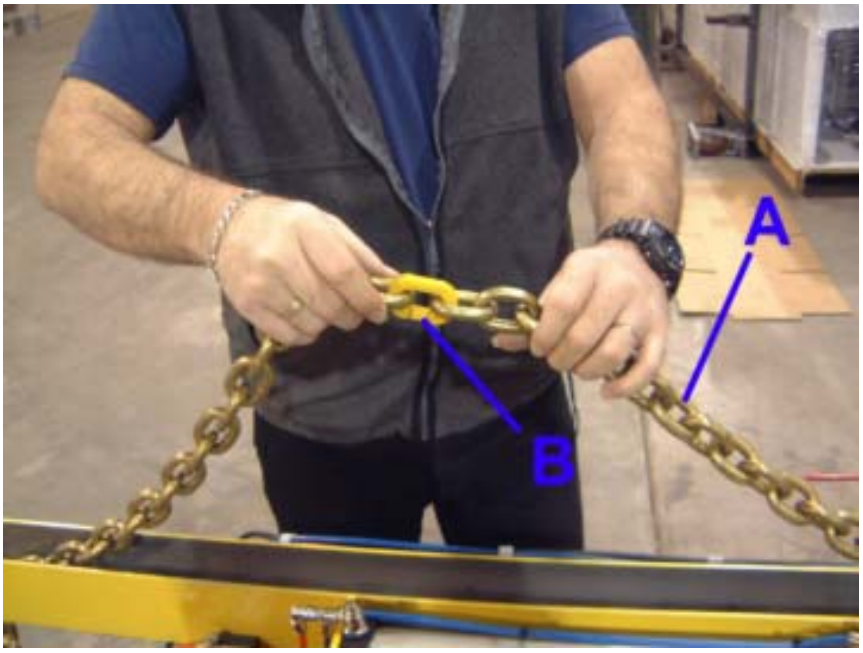


A: RMI 768-1100 MASTERLINK
B: RMI 531-1225 DRIVE MOTOR

FIGURE # 11



A: V- BELTS
B: GEAR REDUCER
FIGURE # 12



A: RMI 768-1026 RSITOW CHAIN
B: RMI 768-1100 RSIMAASTERLINK
FIGURE # 13

A3. Automatic Chain Oiling System Check oil level in reservoir every 24 operating hours and top off as required. (Rec. Lubricant RMI-1130 MPO-30).

1. INJECTORS:

Check each injector for proper operation. After checking for operation adjust injectors for required lubrication.

NOTE: If your system is equipped with a Lubecon Automatic Oiler. See

manual supplied by Lubecon Inc.

B. HORIZONTAL CURVE: (ON-FLOOR)

The curves on on-floor systems are equipped with UHMW. The UHMW (white plastic) should be visually inspected periodically and replaced if damaged or worn to the extent that the Tow-Chain is not held in place properly. No other maintenance or lubrication will be required under normal operating conditions.

C. STRAIGHT TRACK:

Visually inspect all tracks for obstructions or damage daily. (Both ON-FLOOR and IN-FLOOR systems) Check bolts on on-floor track for tightness every 2500 operating hours.

D. HORIZONTAL CURVE: (IN-FLOOR)
Periodically inspect UHMW (White Plastic) for damage and excessive wear (REF. 3.2-B). No other maintenance or lubrication will be required under normal operating conditions.

3.3 TOW CARTS:

All Tow Carts should be periodically visually inspected for damage to stop bar. Flap hinge, pin and pin tube. Lubrication of Tow Cart components will be as follows:

MED. DUTY CASTER SWIVEL BEARING:

Lubricate thru cup hole as follows:
Clean environment: (REF 3.1 - C) Texaco Regal Oil F (R & D) Temp. rating 150°- 500° F or equal (Call RSI, Inc. for equals) every 150 operating hours.

MODERATE ENVIRONMENT:
(REF 3.1 - C) Every 50 operating hours.

DIRTY ENVIRONMENT:
(REF 3.1 - C) Every 20 operating hours.

HEAVY DUTY CASTER SWIVEL BEARING: (see Fig #14)

Lubricate thru Lube Zerk as follows:

CLEAN ENVIRONMENT: (REF page 3 - C) Texaco thermatex Ed-1 temp. rating 350° - 500° F or Texaco low temp. 57 temp rating -40° - 350° F or equal (Call RSI, Inc. for equals) Every 150 operating hours.

MODERATE ENVIRONMENT: (REF page 3 - C) every 50 operating hours.

DIRTY ENVIRONMENT: (REF page 3 - C) Every 20 operating hours.

MED. AND HEAVY DUTY WHEEL BEARINGS: (see Fig #14)

Lubricate thru Lube Zerk as follows:

CLEAN ENVIRONMENT: (REF page 3 - C) Texaco Thermatex ED - 1 Temp. Rating 350° - 500° F or Texaco low Temp. 57 Temp. Rating -40° - 350° F or equal (Call RSI, Inc. for Equal) Every 150 operating hours.

MODERATE ENVIRONMENT: (REF page 3 - C) Every 50 operating hours.

DIRTY ENVIRONMENT: (REF page 3 - C) Every 20 operating hours.

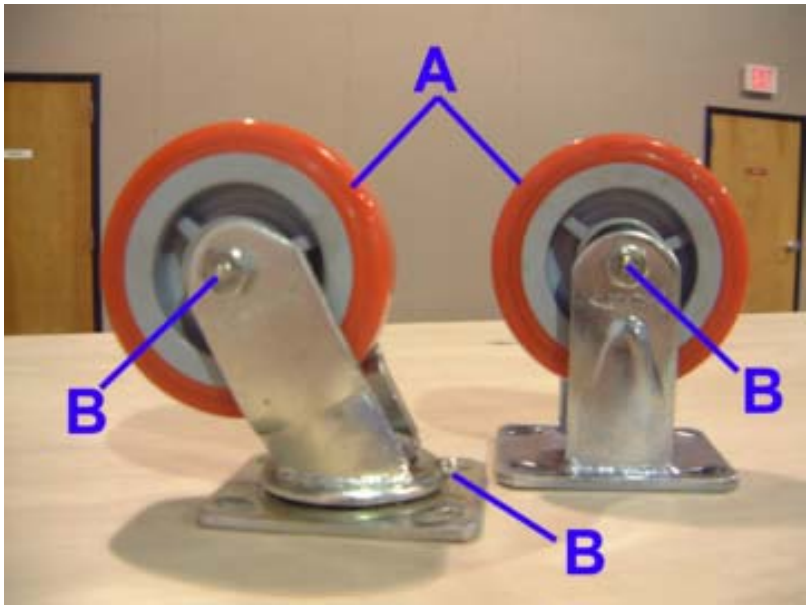
A. CART ASSEMBLY: (see Fig #15)

Tow pin engagement should be checked for point wear. Periodically remove Pin and hone tube with carbon brush. Lubricate pin and tube with State TEF Dry Lube or equal (Call RSI, Inc. for equal) as follows:

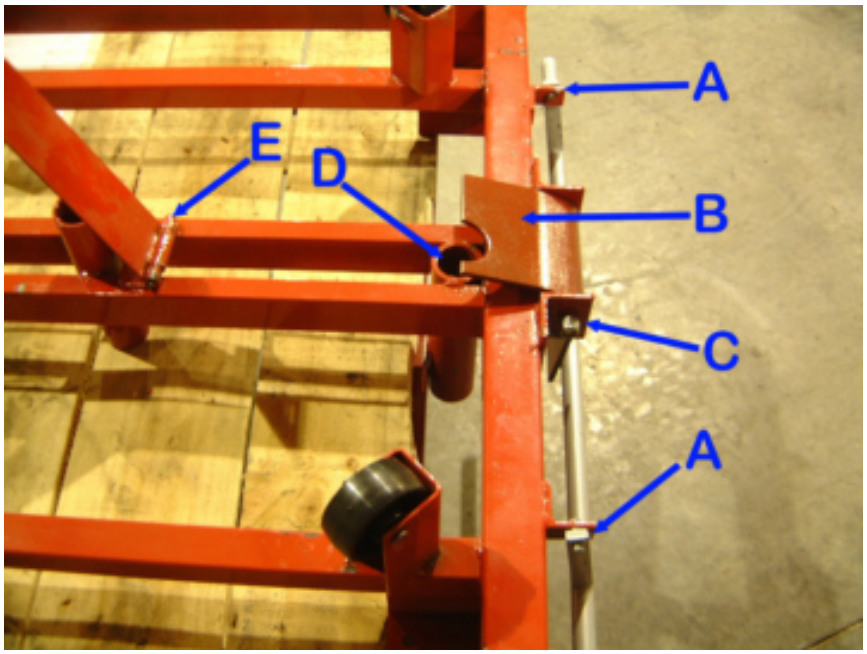
CLEAN ENVIRONMENT: (REF 3.1 - C) Every 100 operating hours.

MODERATE ENVIRONMENT: (REF 3.1 - C) Every 50 operating hours.

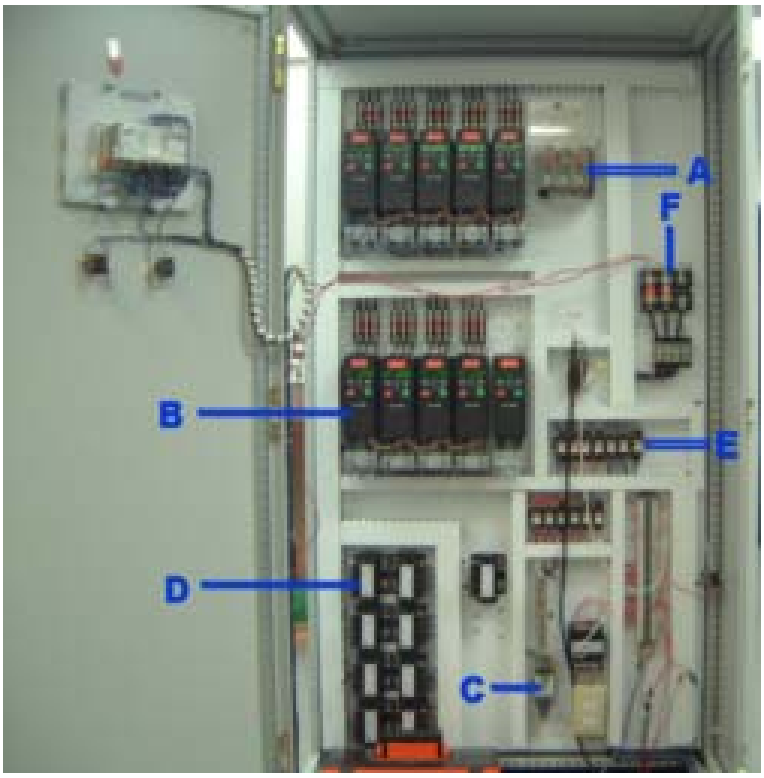
DIRTY ENVIRONMENT: (REF 3.1 - C) Every 20 operating hours.



A: CASTER
B: LUBE FITTING
FIGURE # 14



A: PIVOT AXLE
B: PRIMARY FLAPPER
C: ½" BOLT FOR PRIMARY FLAPPER
D: PIN TUBE
E: SECONDARY LIFT HINGE
FIGURE # 15



A: INPUT FUSES
A1: DISCONNECT HANDLE
B: INVERTER
C: AIR PRESSURE SWITCH
D: 5% FIELD CHOKE
E: LOGIC RELAY
F: MAIN FUSES
G: TOUCH SCREEN

FIGURE # 16 & 17

4.1 TROUBLE SHOOTING:

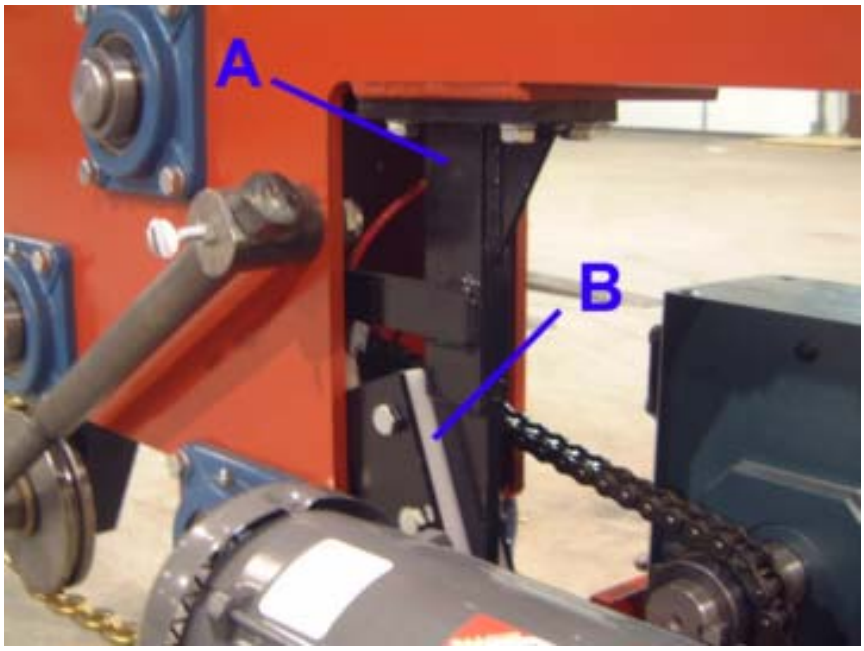
A: DRIVE: (see Fig #17, part B)

The RSI Tow Chain Conveyor is equipped with an Danfoss series 2800 Adjustable Frequency A.C.Drive. This unit has an on board computer that will greatly reduce the time spent on trouble shooting the drive unit. The Danfoss series 2800 is equipped with a local display that will display fault codes. You will find a label on the panel that lists these fault codes for your convenience. These codes are listed in the user manual supplied with all inverters and or control panels.

B. After making adjustments and corrections found in fault codes and diagnostic procedures by symptom sheet. Refer to the Danfoss series 2800 Trouble Shooting Guide.

C. TOW CHAIN JUMPS TEETH ON MAIN DRIVE GEAR:

Check position of chain guide. If chain guide is adjusted to its maximum mechanical allowance. Replace UHMW insert.

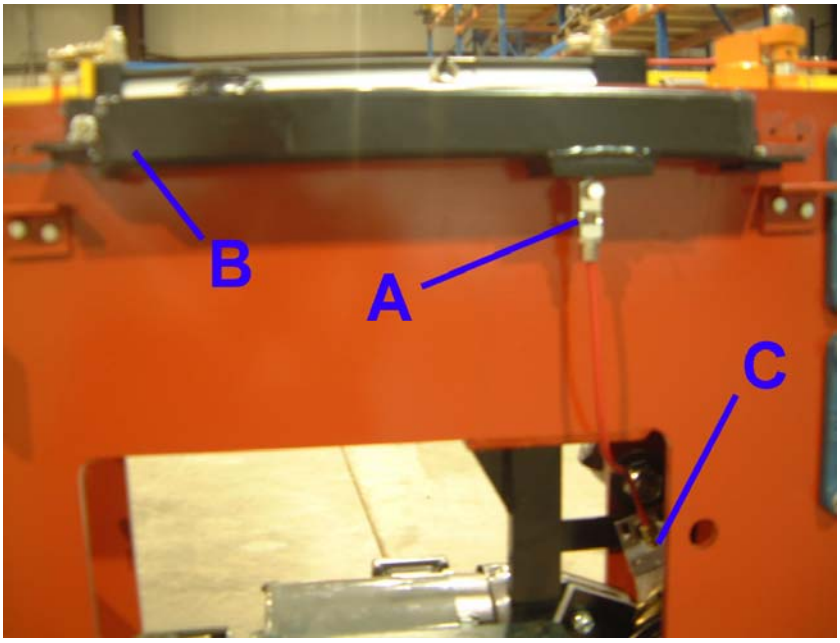


A: CHAIN GUIDE
B: UHMW INSERTS

FIGURE # 18

D. DRIVE RUNS BUT CARTS WILL NOT RELEASE:

Check counter sprocket and/or Proximity Switch:
(CART VALUE, AVG. CART VALUE OR CART ON CALL SYSTEM)



A: PETCOCK W/ SIGHT GLASS
B: RESERVOIR
C: BRUSH

FIGURE # 19

E. SYSTEM HAS OIL PUDDLES AT TURNS:

Check oiler at drive unit(s) for excessive flow, and adjust to approx. 3 drops every min. Gauge through view window. (Fig # 19)

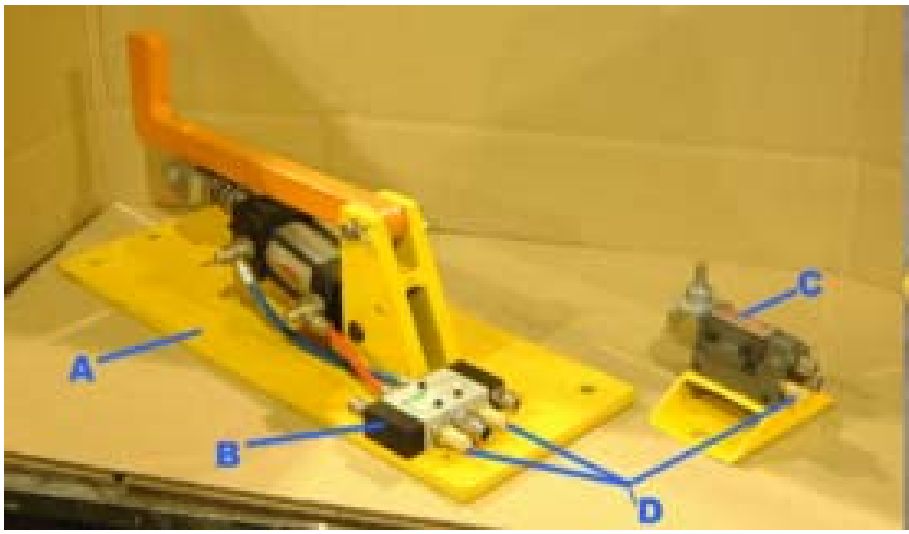
4.2 PNEUMATICS:

Check operation of Air pressure switch first!

Stops not operating properly:

Check for moisture in airlines or compressor.
Check for debris in valves.
Check sequence of limit valves.

Cylinder respond time slows or stops:
Check exhaust mufflers for clogging (Fig. 20).
Check for moisture in airlines.



A: STOP UNIT
B: PILOT VALVE
C: ELECTRIC LIMIT SWITCH
D: EXHAUST MUFFLERS

FIGURE # 20

A: LIMIT WAND
B: ELECTRIC LIMIT SWITCH
C: ELECTRIC SOLENOID

Figure # 21

4.3 ELECTRICAL:

Check operation of air pressure switch first!
Stops not operating properly

Check roller arm to assure proper position on limit switch. Once roller arm is in position tighten nut to hold roller arm in proper position. (See Fig #21)

Check limit switch head for loose screws and/or damage. If limit switches pass visual inspections as listed above and indicator on P.C. board illuminates when limit switch is activated then move on to check electric solenoid valve on station(s) that aren't operating properly.

To check solenoid valve push override on solenoid if valve is operating properly the stop will drop down to release cart. If not the valve may need cleaning or moisture in the air.

Check for loose connection on limit switch and at junction box.

WARNING: BEFORE PERFORMING ANY TYPE OF WORK ON THIS SYSTEM, HAVE THE ELECTRICAL AND AIR TURNED OFF AND LOCKED OUT. UNLESS IT IS OTHERWISE STATED IN THIS MANUAL.

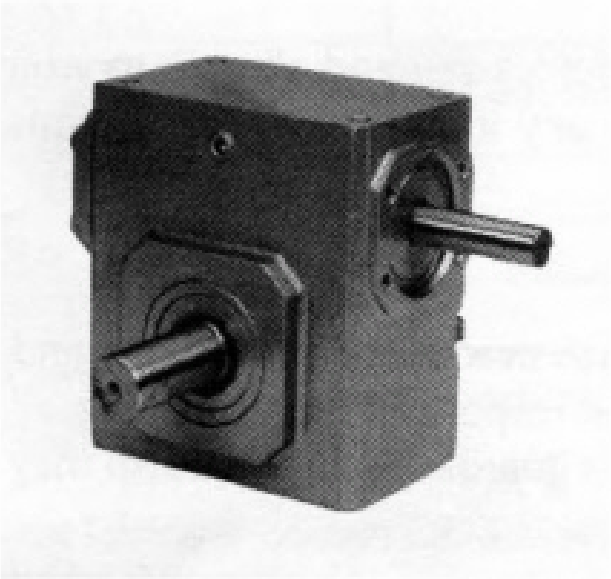
WARNING: A QUALIFIED PERSON SHOULD ONLY DO WORK PERFORMED ON THIS SYSTEM.

WARNING: DO NOT MANUALLY ENGAGE OR DISENGAGE CART ON THE CONVEYOR WHILE IT IS IN OPERATION.

WARNING: KEEP ALL PARTS OF THE ANOTOMY CLEAR OF ANY MOVING PARTS ON THIS SYSTEM.

GROVE GEAR

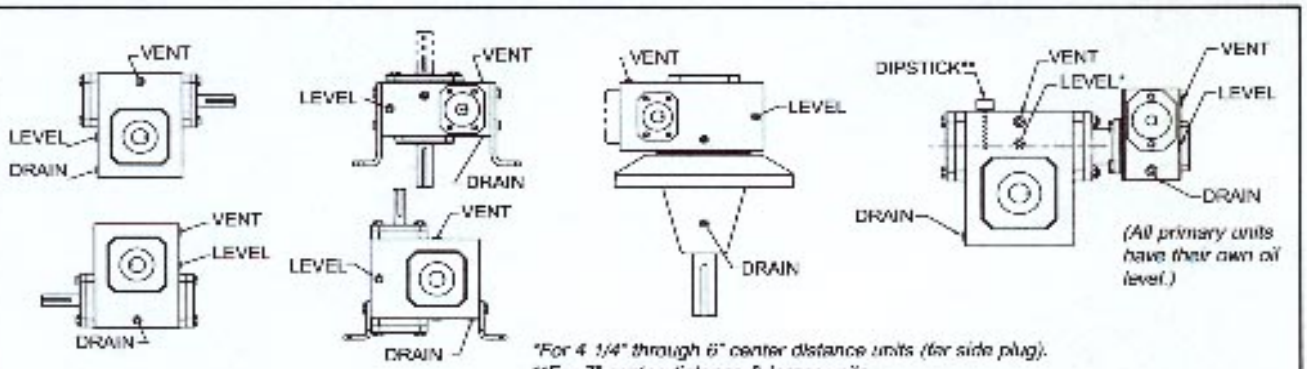
FLEX-A-LINE SPEED REDUCER



Installation, Lubrication, and Maintenance Instructions

Instructions Manual

Standard Speed Reducer Mounting Positions & Vent Plug, Level and Drain Locations



*For 4 1/4" through 6" center distance units (for side plug).
**For 7" center distance & larger units.
Note: High oil level applies to all 4 1/4" center distance & larger secondary & tertiary units regardless of primary unit type.

Maintenance

Your Grove Gear reducer has been tested and adjusted at the factory. Dismantling or replacement of components must be done by Grove Gear to maintain the warranty.

Frequently check the oil level of the reducer. If oil level is low, (refer to reducer vent and level position chart) add proper lubrication through the filler plug until it comes out the oil level plug.

Inspect vent plug often to insure it is clean and operating.

CAUTION: Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.

Seals: The Grove Gear line of speed reducers utilize premium quality seals which are the state-of-the-art in sealing technology. Seals are, however, a wear item and eventually need to be replaced. Replacement can be easily accomplished by following the steps below:

1. Remove the worn seal without damaging the shaft surface or the seal bore. This can be done by drilling a .062 diameter hole in the seal casing (being careful not to drill into the bearing behind the seal). Screw a #10 sheet metal screw into the hole and pry out the seal.
2. Clean the seal bore of sealant.
3. Before installing the new seal, use electrical tape to cover any keyways on the shaft to prevent seal lip damage.
4. Grease the seal lips with bearing grease and apply a sealant to the seal bore.
5. Slide the seal into the shaft being careful not to fold the inner lip over on any shaft steps.
6. Press the seal into its bore with a sleeve that presses on the seal casing, being careful to keep the seal square in its bore.

Class of Service

All capacity ratings are based on American Gear Manufacturers Association (AGMA) Standards. Load conditions be within cataloged ratings published in the current Grove Gear Catalog (available upon request).

Manufacturer	30° to 100° F Ambient Temperature AGMA Compounded No. 7	50° to 125° F Ambient Temperature AGMA Compounded No. 8
Amoco Oil Co.	Worm Gear Oil	Cylinder Oil #680
Chevron USA, Inc.	Cylinder Oil #460X	Cylinder Oil #680X
Exxon Co. USA	Cylesstic TK-460	Cylesstic TK-680
Gulf Oil Co.	Senate 460	Senate 680D
Mobil Oil Corp.	600 W Super Cylinder	Extra Hecla Super
Shell Oil Co.	Valvata Oil J460	Valvata Oil J680
Sun Oil Co.	Gear Oil 7C	Gear Oil 8C
Texaco	Honor Cylinder Oil	650T Cylinder Oil
Union Oil Co. of CA	Steaval A	Worm Gear Lube 140

Standard factory-installed lubricant, shipped with 6.00" C.D. and smaller units.

Some gear lubricants contain E.P. additives that can be corrosive to gear bronze. Avoid lubricants that are compounded with sulfur and/or chlorine.

For temperature ranges not shown, contact factory.

For lubrication requirements of helical reducers (primaries of helical/worm reducers, ratio multipliers, and styles BAMCQ, BAMC, and BA), contact factory.

Oil Capacities (pints)

Mounting Position	UNIT SIZE													
	213	215	217	220	224	226	230	232	242	252	2600	2700*	2800*	21000*
Worm Over	1/2	3/4	1	1 1/2	1 3/4	3	3 3/4	5	8 1/4	12 1/2	19 1/2	35	48	72
Worm Under	1/2	3/4	1	1 1/2	1 3/4	3	3 3/4	5 1/2	8	13 1/2	20 1/2	32 3/4	51 1/4	80
Vertical Output	1/2	3/4	1	1 1/2	1 3/4	3	3 3/4	5	8	13 1/2	20	20 3/4	28 3/4	40
Vertical Input	1/2	3/4	1	1 1/2	1 3/4	3	3 3/4	5	8	13 1/2	20 1/3	36 1/2	50	75
Extended Bearing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	12	17	27	40	63	102
Worm over on Secondary Unit of Double Reduction				N/A	N/A	N/A	N/A	12	19 1/4	20	30 1/3	50 1/3	71 1/2	107 1/4

*Shipped Dry

16 oz. = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
1 gallon = 128 oz. = 231 cu. in.

Always check for proper oil level after filling. Capacities vary somewhat with model and mounting position. Oil should rise to bottom edge of level hole. Do not overfill.

Synthetic Lubricants

Synthetic lubricants provide the potential for numerous benefits including wider operating temperature range and increased interval between changes. Use of synthetics can cause problems if they are not compatible with the seals or the conventional lubricants they replace. For normal ambient temperatures (-10°F to 105°F) we recommend the use of Mobil SHC 634 which is compatible with the standard compounded oil shipped in our product and the Viton® seal material used through size 252. For other temperatures, contact factory for a recommendation.

Lubrication

With the exception of unit sizes 2700, 2800 and 21000 which are shipped dry, all standard reducers ordered from the factory are filled with lubricant to operate within a 30° to100° F ambient temperature range. Double and triple reduction units have separate oil sumps and must be filled/checked independently. Prior to startup, verify that the oil is at the level shown on the drawings on page 166. If the ambient temperature will be outside the range for the lubricant installed at the factory, drain and refill the reducer with the proper viscosity lubricant prior to use. Consult the chart on page 177 or the factory for alternate lubricants.

Change Intervals: Standard compounded lubricants should be changed every six months or 2500 operating hours, whichever comes first. Factory installed synthetic lubricants should be changed every two years or 6000 hours, whichever comes first.

Internal pressure compensating system: Grove Gold and stainless steel reducers come standard with an internal pressure compensating system and synthetic oil pre-installed at the factory. It is not necessary to vent these reducers, and they can be used as supplied from the factory.

CAUTION: Oil should be changed more often if reducer is used in a severe environment. *(i.e. dusty, humid)*

CAUTION: In the Food and Drug Industry (including animal food), consult the lubrication supplier for recommendation of lubricants which are acceptable to the Food and Drug Administration and/or other authoritative bodies having jurisdiction. Factory supplied oil is not suitable for these applications or this industry.

Special Lubrication Requirements - Sizes 218 & Larger

Units shipped from the factory are assembled to properly lubricate all internal components based on a specific assumed mounting orientation. The factory assumed mounting orientations are given below. If a size 218 or larger unit will be mounted in a different orientation than listed below, or run with sustained input speeds less than 900 RPM, it should be specified with the order. The unit can then be modified to assure proper lubrication.

Factory Assumed Mounting Orientation	Applicable Unit Styles*	
Worm Over	B, T, F, H, FH, C,	Single Reduction
	D, DT, DF, DH, DFH	Double Reduction Worm-Worm
	DX, DXT, DXH, DXFH,	Double Reduction Helical-Worm
	TT	Triple Reduction Worm-Worm-Worm
Worm Under	U	Single Reduction
	DU	Double Reduction Worm-Worm
Vertical Output	VL/VH, FE	Single Reduction
	DVL/DVH, DFE	Double Reduction Worm-Worm
	DXVL/DXVH, DXFE	Double Reduction Helical-Worm

General Operation

1. Run the motor which drives the reducer and check the direction of reducer output rotation. Consult motor nameplate for instructions to reverse the direction of rotation.
2. Attaching the load: On direct coupled installations, check shaft and coupling alignment between speed reducer and loading mechanism. On chain/sprocket and belt/pulley installation, locate the sprocket or pulley as close to the oil seal as possible to minimize overhung load. Check to verify that the overhung load does not exceed specifications published in the catalog.
3. High momentum loads: If coasting to a stop is undesirable, a braking mechanism should be provided to the speed reducer output or the driven mechanism.

CAUTION: The system of connected rotating parts must be free from critical speed, torsional or other type vibration, no matter how induced. The responsibility for this system analysis lies with the purchaser of the speed reducer.

Installation

1. Mount the unit to a rigid flat surface using grade 5 or higher fasteners. The mounting fasteners should be the largest standard size that will fit in the base mounting hole. Shim as required under flange or base feet which do not lie flat against the mounting surface.
2. For shipment, pipe plugs are installed in the unit and a vent plug is packed separately. After mounting the unit in position, remove the appropriate pipe plug and install the vent plug in the location shown on page 166. On double reduction units both the primary and the secondary must be vented. Failure to vent the unit can cause premature seal wear or loss of seal and oil. These conditions are not covered by warranty. Check for correct oil level. Contact the factory for level and vent recommendations on non-standard mounting positions. Units with optional internal pressure compensating system do not use vents. See (internal pressure compensating system) under **Lubrication** for further information.
3. Connect motor to speed reducer.

⚠ **WARNING:** Depending upon gear geometry and operating conditions worm gear reducers may or may not backdrive. Special consideration should be given to high inertia loads connected to the output shaft. Consult the factory for further details.

CAUTION: DO NOT CHANGE MOUNTING POSITIONS WITHOUT CONTACTING FACTORY. Altering the mounting position may require special lubrication provisions which must be factory installed.

CAUTION: Do not operate the reducer without making sure it contains the correct amount of oil. Do not overfill or underfill with oil, or injury to personnel, reducer or other equipment may result.

CAUTION: A unit cannot be used as an integral part of a machine superstructure which would impose additional loads on the unit other than those imposed by the torque being transmitted either through a shaft-mounted arrangement, and any shaft mounted power transmitting device. *(e.g. sprockets, pulleys, couplings)*

CAUTION: For safe operation and to maintain the unit warranty, when changing a factory installed fastener for any reason, it becomes the responsibility of the person making the change to properly account for fastener grade, thread engagement, load, tightening torque and the means of torque retention.

Instructions Manual

Selection Information

Read ALL instructions prior to operating reducer. Injury to personnel or reducer failure may be caused by improper installation, maintenance or operation.

Written authorization from Grove Gear is required to operate or use reducers in man lift or people moving devices.

Check to make certain application does not exceed the allowable load capacities published in the current catalog.

Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which buyer shall apply the product. The application by buyer shall not be subject to any implied warranty of fitness for a particular purpose.

Safety Alert

⚠ WARNING: For safety, purchaser or user should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The user is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.

⚠ WARNING: Hot oil or reducers can cause severe burns. Use extreme care when removing lubrication plugs and vents.

⚠ WARNING: Make certain that the power supply is disconnected before attempting to service or remove any components. Lock out the power supply and tag it to prevent unexpected application of power.

⚠ WARNING: Reducers are not to be considered fail safe or self-locking devices. If these features are required, a properly sized, independent holding device should be utilized.

⚠ WARNING: Any brakes that are used in conjunction with a reducer must be sized or positioned in such a way so as to not subject the reducer to loads beyond the catalog rating.

CAUTION: Test run unit to verify operation. If the unit tested is a prototype, that unit must be of current production.

CAUTION: If the speed reducer cannot be located in a clear and dry area with access to adequate cooling air supply, then precautions must be taken to avoid the ingestion of contaminants such as water and the reduction in cooling ability due to exterior contaminants. Reducers located in confined spaces may require forced air cooling.

Important Information

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranty or representations, expressed or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the good sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will manufacturer be liable for consequential, incidental or other damages.

Electrical Safety and This Control Panel

ELECTRICAL SAFETY CONSIDERATIONS

- NEVER WORK ALONE ON ELECTRICAL EQUIPMENT. YOU SHOULD ***ALWAYS*** HAVE A SAFETY PERSON WATCHING YOU WORK. This person should know CPR and emergency response regarding electrocution.
- Only qualified personnel should do electrical service work.
- Always wear cotton work cloths. Never wear polyester work uniforms as they will stick to your skin when they catch fire and make the burns you receive much worse than they normally would have been.
- Never assume that the equipment being serviced is shut down unless you personally have seen the disconnect pulled, locked out with your equipment, and tagged.
- Never open a control or work on an electrical device with the power on unless you are fully qualified to do so.
- Follow prescribed lock out procedures prior to starting any service on electrical equipment.
- There should be 72" of free space in front of any electrical panel.
- Isolation mats should be placed in front of electrical panels.
- A safety disconnect switch should be with in 30 feet of, or in sight of, any electric motor.
- Never change fuses with the power on. Use only approved fuse pulling pliers. Slip joint pliers, like Channel Locks are for pipe, they will bite you when used as a fuse puller.
- Remember that even small signals can be lethal. It is possible to be electrocuted by a 9 volt battery under the right conditions.
- Shielded wires are especially dangerous. The shield can self pump to several thousand volts when improperly handled. Prior to working on any shielded wire for any reason, clip the shield to a known ground.
- Conductors feeding high impedance devices can have ultra-high voltage levels on them. Treat these wires with a great deal of respect since they can be instantly

If you are qualified to work on an open control panel and circumstances *require* that the power be on; then treat every conductor as if it had lethal voltages present, be aware of grounding, use only double insulated tools, and follow hot panel protocols.

- When initiating power flow to an open panel, **always** turn your head away from the enclosure and close your eyes, when closing the switch.

- If you should happen to contact a live wire and receive a shock, seek medical advise on the proper course of action to take regarding your future health. In some cases, admittance to a hospital for observation may be required for one or more days as heart and nerve problems associated with electrical contact can take time to manifest themselves.

- If working with DC or synchronous motors, always put a shunt bar across the motor leads. If the motor shaft is turned while you are working on the equipment, the motor will become a generator and can electrocute you.

If working on equipment with current transformer(s) (CT●s or doughnuts), shunt the leads to prevent high voltage encounters.

ATTENTION:

Servicing energized Industrial Control Equipment can be hazardous.

Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment.

Recommended practice is to disconnect and lockout control equipment from power sources, and release stored energy, if present.

Refer to National Fire Protection Association Standard No. NFPA70E, Part II and (as applicable) *OSHA rules for Control of Hazardous Energy Sources* (Lockout-Tagout) and; *OSHA Electrical Safety Related Work Practices* for safety related work practices, including procedural requirements for lockout-tag out, and appropriate work practices, personnel qualifications and training requirements. This absolutely necessary where it is not feasible to de-energize and lockout or tag out electric circuits and equipment before working on or near exposed circuit parts.

ATTENTION:
Explosion hazard. Always disconnect power before opening enclosures in hazardous locations. Close and secure such enclosures before reapplying power.

PERIODIC INSPECTION

Industrial control equipment should be inspected periodically. Inspection intervals should be based on environmental and operating conditions and adjusted as indicated by experience. An initial inspection within 3 to 4 months after installation is suggested.

See National Electrical Manufacturers Association (NEMA) Standard No. ICS 1.3, *Preventive Maintenance of Industrial Control and Systems Equipment*, for general guidelines for setting-up a periodic maintenance program.

We suggest that a periodic maintenance program is set up. Some specific guidelines for our products are listed below.

CONTAMINATION

If inspection reveals that dust, dirt, moisture or other contamination has reached the control equipment, the cause must be eliminated. This could indicate an ineffective enclosure, unsealed enclosure openings (conduit or other) or incorrect operating procedures.

Replace any damaged or embrittled elastomer seals and repair or replace any other damaged or malfunctioning parts (e.g., hinges, fasteners, etc.).

Dirty, wet or contaminated control devices must be replaced unless they can be cleaned effectively by vacuuming or wiping.

Compressed air is not recommended for cleaning because it may displace dirt, dust, or debris into other parts or equipment, or damage delicate parts.

COOLING DEVICES

Inspect blowers and fans used for forced air-cooling. Replace any that have bent, chipped, or missing blades, or if the shaft does not turn freely. Apply power momentarily to check operation. If unit does not operate, check and replace wiring, fuse, or blower or fan motor as appropriate.

Clean or change air filters as recommended in the product manual. Also, clean fins of heat exchangers so convection cooling is not impaired.

HAZARDOUS LOCATION ENCLOSURES

ATTENTION: EXPLOSION HAZARD

Always disconnect power before opening enclosures in hazardous locations. Close and secure such h enclosures before reapplying power.

NEMA Types 7 and 9 enclosures require careful handling so machined flanges do not get damaged. For removable covers, remove the cover and set aside with machined surface up. For hinged covers, open the cover fully and restrain in the full open position if necessary.

Clean and examine the flanges on both the body and cover before reassembly. If there are scratches, nicks, grooves or rust on the mating surfaces, replace the body or cover as necessary.

Examine all bolts and replace any that have damaged threads. Also check mating threads for damage and replace enclosure if necessary.

Covers and bodies of some enclosures are manufactured as matched sets (not interchangeable). The manufacturer should be consulted before replacing a cover or body unless it is specified by the manufacturer as interchangeable.

OPERATING MECHANISMS

Check for proper functioning and freedom from sticking or binding.

Replace any broken, deformed or badly worn parts or assemblies according to individual product renewal parts lists.

Check for and re-tighten securely any loose fasteners.

Lubricate if specified in individual product instructions.

Note: Some magnetic starters, contactors and relays are designed to operate without lubrication - do not lubricate these devices because oil or grease on the pole faces (mating surfaces) of the operating magnet may cause the device to stick in the "ON" mode.

Some parts of other devices are factory-lubricated - if lubrication during use or maintenance of these devices is needed, it will be specified in their individual instructions. If in doubt, consult the manufacturers sales office for information.

CONTACTS

Check contacts for excessive wear and dirt accumulations. Vacuum or wipe contacts with a soft cloth if necessary to remove dirt. Contacts are not harmed by discoloration and slight pitting.

Contacts should never be filed, as dressing only shortens contact life. Contact spray cleaners should not be used as their residues on magnet pole faces or in operating mechanisms may cause sticking, and on contacts can interfere with electrical continuity.

Contacts should only be replaced after silver has become badly worn. Always replace contacts in complete sets to avoid misalignment and uneven contact pressure.

VACUUM CONTACTORS

Contacts of vacuum contactors are not visible, so contact wear must be checked indirectly. Vacuum bottles should be replaced when:

1 .The estimated number of operations equals one million, or
2. The contact life line indicator shows need for replacement, or
3. The vacuum bottle integrity tests show need for replacement.

Replace all vacuum bottles in the contactor at the same time to avoid misalignment and uneven contact wear. If the vacuum bottles do not require replacement, check and adjust over travel to the value listed on the maintenance instructions.

TERMINALS

Loose connections in power circuits can cause overheating that can lead to equipment malfunction or failure.

Loose connections in control circuits can cause control malfunctions.

Loose bonding or grounding connections can increase hazards of electrical shock and contribute to electromagnetic interference (EMI).

Check the tightness of all terminals and bus bar connections and tighten securely any loose connections.

Replace any parts or wiring damaged by overheating, and any broken wires or bonding straps.

ARC HOODS

Check for cracks, breaks, or deep erosion. Arc hoods and arc chutes should be replaced if damaged or deeply eroded.

COILS

If a coil exhibits evidence of overheating (cracked, melted or burned insulation), it must be replaced. In that event, check for and correct over voltage or under voltage conditions, which can cause coil failure. Be sure to clean any residues of melted coil insulation from other parts of the device or replace such parts.

BATTERIES

Replace batteries periodically as specified in product manual or if a battery shows signs of electrolyte leakage. Use tools to handle batteries that have leaked electrolyte; most electrolytes are corrosive and can cause burns. Dispose of the old battery in accordance with instructions supplied with the new battery or as specified in the manual for the product.

PILOT LIGHTS

Replace any burned out lamps or damaged lenses.

PHOTOELECTRIC SWITCHES

The lenses of photoelectric switches require periodic cleaning with a soft dry cloth. Reflective devices used in conjunction with photoelectric switches also require periodic cleaning. Do not use solvents or cleaning agents on the lenses or reflectors. Replace any damaged lenses and reflectors.

SOLID-STATE DEVICES

-- ATTENTION --

Use of other than factory recommended test equipment for solid-state controls may result in damage to the control or test equipment or unintended actuation of the controlled equipment. Refer to paragraph titled HIGH VOLTAGE TESTING. Solid-state devices require little more than a periodic visual inspection. Discolored, charred or burned components may indicate the need to replace the component or circuit board. Necessary replacements should be made only at the PC board or plug-in component level. Printed circuit boards should be inspected to determine whether they are properly seated in the edge board connectors. Board locking tabs should also be in place. Solid-state devices must also be protected from contamination, and cooling provisions must be maintained refer to paragraphs titled CONTAMINATION and COOLING DEVICES on previous page.

Solvents should not be used on printed circuit boards.

NOTE: HIGH VOLTAGE TESTING

High voltage insulation resistance (IR) and dielectric withstanding voltage (DWV) tests should not be used to check solid-state control equipment.

When measuring IR or DWV of electrical equipment such as transformers or motors, a solid-state device used for control or monitoring must be disconnected before performing the test. Even though no damage is readily apparent after an IR or DWV test, the solid-state devices are degraded and repeated application of high voltage can lead to failure.

LOCKING AND INTERLOCKING DEVICES

Check these devices for proper working condition and capability of performing their intended functions. Make any necessary replacements only with the same brand of renewal parts or kits. Adjust or repair only in accordance with manufacturers instructions.

MAINTENANCE AFTER A FAULT CONDITION

Opening of the short circuit protective device (such as fuses or circuit breakers) in a properly coordinated branch circuit is an indication of a fault condition in excess of operating overload.

Such conditions can cause damage to control equipment.

Before restoring power, the fault condition must be corrected and any necessary repairs or replacements must be made to restore the control equipment to good working order.

Refer to NEMA *Standards Publication* No. ICS-2, Part ICS2-302 for procedures.

REPLACEMENTS

Use only replacement parts and devices recommended by the manufacturer to maintain the integrity of the equipment. Make sure the parts are properly matched to the model, series and revision level of the equipment.

FINAL CHECK OUT

After maintenance or repair of industrial controls, always test the control system for proper functioning under controlled conditions that avoid hazards in the event of a control malfunction.

For additional information, refer to *NEMA ICS 1.3, PREVENTIVE MAINTENANCE OF INDUSTRIAL CONTROL AND SYSTEMS EQUIPMENT*, published by the National Electrical Manufacturers Association, and NFPA70B, *ELECTRICAL EQUIPMENT MAINTENANCE*, published by the National Fire Protection Association.

ATTENTION: Use of other than factory recommended test equipment for solid-state controls may result in damage to the control or test equipment or unintended actuation of the controlled equipment. Refer to paragraph titled HIGH VOLTAGE TESTING.

GENERAL TROUBLE GUIDE FOR DANFOSS VARIABLE FREQUENCY DRIVES

October 26, 2001
v1.1

General warning;

The voltage of the adjustable frequency drive is dangerous whenever the drive is connected to the AC line. Incorrect installation of the motor or drive may cause damage to the equipment, serious injury or death. Comply with the safety instructions in this manual as well as local and national rules and safety regulations.

These rules concern your safety;

1. Disconnect the adjustable frequency drive from the AC line if repair work is to be carried out. Wait 4 minutes to allow for electrical discharge before removing motor and AC line connectors.

2. The [STOP/RESET] key on the control panel of the adjustable frequency drive does not disconnect the equipment from the AC line. Do not use it as a safety switch.

3. The unit must be grounded correctly. The user must be protected against supply voltage and the motor protected against overload in accordance with applicable national and local regulations.

4. The ground leakage currents are higher than 3.5 mA.

5. Protection against motor overload is not included in the factory setting. If this function is required, set parameter 128 *Motor thermal protection to ETR trip or ETR warning.* For North America, the ETR functions provide class 20 overload protection for the motor in accordance with NEC requirements.

6. Do not remove the terminal plugs for the motor and AC line supply while the adjustable frequency drive is connected to the AC line. Ensure that the AC line supply has been disconnected and that 4 minutes has passed before removing motor and AC line plugs.

7. The DC bus terminals are another high voltage input that must be disconnected before servicing the drive. Ensure that all voltage inputs have been disconnected and that 4 minutes has passed before repair work begins.

Warnings against unintended start:

1. The motor can be started by means of digital commands, bus commands, references or a local start command whenever the drive is connected to the AC line. Therefore, an unintended start may occur anytime power is applied. Never service the drive or equipment when power is applied to the drive.

2. The motor may start while parameters are being changed. Always activate the stop key [STOP/ RESET] by pressing it before data is modified.

3. A motor that has been stopped may start if faults occur in the electronics of the drive, or if a temporary overload or fault clears in the AC line or motor connection.

Motor overload protection

The electronic thermal relay (ETR) in UL listed VLTs provides Class 20 motor overload protection in accordance with the NEC in single motor applications when parameter 128 is set for "ETR TRIP" and parameter 105 *Motor current* is set for the rated motor current.

Warning:

It can be extremely dangerous to touch the electrical parts even when the mains supply has been disconnected. Also ensure that other voltage inputs are disconnected from load sharing through the DC bus. Wait at least 4 minutes after the input power has been removed before servicing the drive.

INSTALLATION:

Special conditions

Extreme environments

An adjustable frequency drive contains a number of mechanical and electronic components which are vulnerable to environmental impact.

Do not install the adjustable frequency drive in environments where liquids, particles or gases in the air would damage the electronics of the drive. Take all necessary measures to protect the drive. There is a risk of fault and reduced service life of the drive.

Liquids carried through the air can condense in the adjustable frequency drive. Liquids may facilitate galvanic corrosion of components and metal parts. Steam, oil and brine may also cause corrosion of components and metal parts. In these areas, it is recommended to install units in cabinets. As a minimum, cabinets should meet NEMA 12 requirements.

Particles in the air, such as dust, may lead to mechanical, electrical and thermal faults in the adjustable frequency drive. A typical indicator of too many particles in the air is dust around the fan. In very dusty areas, mounting the drive in a cabinet is recommended. As a minimum, cabinets should meet NEMA 12 requirements.

Aggressive gases, such as sulfur, nitrogen and chlorine compounds, together with high humidity and temperature, facilitate possible chemical processes on the components of the adjustable frequency drive. These chemical processes quickly damage the electronics. In these areas, mounting in a cabinet with fresh air circulation is recommended, thereby ensuring that aggressive gases are kept away from the drive.

NOTE!
Installation of adjustable frequency drives in extreme environments increases the risk of down-time, and considerable reduction of the service life of the drive.

Before the adjustable frequency drive is installed, check whether there are liquids, particles or gases in the air. Examine existing installations in the same environment. Typical indicators of harmful airborne liquids are water or oil on metal parts or corrosion. Too many dust particles are typically observed on top of cabinets. Indication of aggressive gases in the air are black copper rails and cable ends on existing electrical installations.

Galvanic isolation (PELV)

PELV (Protective Extra-Low Voltage) separation is achieved with galvanic separators between control circuits and circuits connected to the AC line potential. These separators meet the requirements for increased isolation in standard EN 50 178. Installation must be in accordance with local and national PELV regulations.

All control terminals, terminals for serial communication and relay terminals are safely separated from the AC line potential, i.e. they comply with the PELV requirements. Circuits that are connected to control components and metal parts. In these areas, it is terminals 12, 18, 19, 20, 27, 29, 33, 42, 46, 50, 55, 53 and 60 are galvanically connected to one another. Serial communication connected to terminals 67 - 70 are galvanically isolated from the control terminals, although this is only a functional isolation. The relay contacts in terminals 1 - 3 are separated from the other control circuits with increased isolation, i.e. these comply with PELV even if there is AC line potential in the relay terminals.

The circuit elements described below form the safe electric separation. They fulfill the requirements for increased isolation and associated testing pursuant to EN 50 178.

1. Optical isolation between basic motor control and control card.
2. Optical isolation between basic motor control and control card.
3. Isolation between the control card and the power part.
4. Relay contacts and terminals relating to other circuits on the control card.

For VLT 2800 series:

PELV isolation of the control card is guaranteed under the following conditions:
- TT network with maximum 300 Vrms between phase and ground
-TN network with maximum 300 Vrms between phase and ground.
-IT network with maximum 400 Vrms between phase and ground.

ERROR CODES AND WHAT TO DO ABOUT THEM --

Warnings/alarm messages and corrective actions

The table below gives the drive's warnings and and alarms and indicates whether the fault trip locks the drive. After a Trip Lock Fault, the input power must be removed, the cause of the fault corrected, and input power restored to reset the drive. A simple Trip can be reset manually in any one of three ways:

1. Pressing the keypad key RESET
2. A digital input
3. Serial communication

In addition, an automatic reset may be selected in parameter 405, *Reset function* which will reset all non-trip lock faults.

Wherever an "X" is placed under both Warning and Alarm in the table below, this means that a Warning precedes the Alarm. It can also mean that it is possible to program whether a given fault is to result in a Warning or an Alarm. This is possible, for example, through parameter 128, *Motor therrnal protection.* After a trip, the motor will be coasting and the drive's Alarm and Warning indications will flash. If the fault is removed, only the Alarm will flash. After a reset, the drive will be ready to start operation again.

In the following detailed descriptions of warning and alarm messages, corrective actions to resolve the condition are recommended.

No.	Description	Warn	Alarm	Trip locked
2	Live zero error (LIVE ZERO ERROR)	X	X	X
4	AC line phase loss (AC LINE PHASE LOSS)	X	X	X
5	Voltage warning high (DC LINK VOLTAGE HIGH)	X		
6	Voltage warning low (DC LINK VOLTAGE LOW)	X		
7	Overvoltage (DC LINK OVER VOLT)	X	X	X
8	Undervoltage (DC LINK UNDERVOLT)	X	X	X
9	Inverter overload (INVERTER TIME)	X	X	
10	Motor overloaded (MOTOR, TIME)	X	X	
11	Motor thermistor (MOTOR THERMISTOR)	X	X	

No.	Description	Warn	Alarm	Trip locked
12	Current limit (CURRENT LIMIT)	X	X	
13	Overcurrent (OVERCURRENT)	X	X	X
14	Ground fault (GROUND FAULT)		X	X
15	Switch mode fault (SWITCH MODE FAULT)		X	X
16	Short-circuit (CURR. SHORT CIRCUIT)	X	X	
17	Serial communication timeout (STD BUS TIMEOUT)	X	X	
18	HPFB bus timeout (HPFB TIMEOUT)	X	X	
33	Out of frequency range (OUT FREQ RNG/ROT LIM)	X		
34	HPFB communication fault (PROFIBUS OPT. FAULT)	X	X	
35	Inrush fault (INRUSH FAULT)	X	X	X
36	Overtemperature (OVERTEMPERATURE)	X	X	X
37-45	Internal fault (INTERNAL FAULT)		X	X
50	AMT not possible		X	
51	AMT fault re. nameplate data (AMT TYPE.DATA FAULT)			X
54	AMT wrong motor (AMT WRONG MOTOR)		X	
55	AMT timeout (AMT TIMEOUT)		X	
56	AMT warning during AMT (AMT WARN. DURING AMT)		X	
99	Locked (LOCKED)	X		

LED indication -- Warning = yellow; Alarm = red; Trip locked = yellow and red

WARNING/ALARM 2. Live zero fault
The voltage or current signal on terminal 53 or 60 is below 50% of the preset value in parameter 309 or *315 Terminal, min. scaling.*

WARNING/ALARM 4: AC line phase fault
Missing phase on AC line supply side.

Check the supply voltage to the adjustable frequency drive. This fault is only active in 3-phase AC line.

WARNING 5: Voltage warning high
If the DC bus voltage (VDC) is higher than *Voltage warning high,* the adjustable frequency drive will give a warning and the motor will continue to operate unchanged.

Check whether the supply voltage matches the rating of the adjustable frequency drive. (See *Technical* data.) If the VDC remains above the voltage warning limit, the inverter will trip after a fixed period of time. The time depends on the unit and is set at 5 - 10 sec.

NOTE: The adjustable frequency drive will trip with an alarm 7 (over voltage). A voltage warning can also occur if the motor frequency is reduced too quickly due to the ramp down time being too short.

WARNING 6: Voltage warning low
If the DC bus voltage (VDC) is lower than *Voltage warn low,* the adjustable frequency drive will give a warning and the motor will continue to operate unchanged.

Check whether the supply voltage matches the rating of the adjustable frequency drive. (See *Technical data.)* If the VDC remains below the voltage warning limit, the inverter will trip after a fixed period of time. The time depends on the unit and is set at 2 - 25 sec.

NOTE: The adjustable frequency drive will trip with an alarm 5 (under voltage). When the adjustable frequency drive is switched off, a warning 6 (and warning 8) is displayed briefly.

WARNING/ALARM 7: Over voltage

If the DC bus voltage (VDC) is higher than the inverter's *Over voltage limit,* the inverter will switch off until the VDC once more falls below the over voltage limit. If the VDC remains above the over voltage limit, the inverter will trip after a fixed period of time. The time depends on the unit and is set at 5 - 10 sec.

NOTE: Voltage warning high (warning 5) will thus also be able to generate an alarm 7. An over voltage in the DC bus can occur if the motor frequency is reduced too quickly due to ramp-down time being too short.

WARNING/ALARM 8: Under voltage
If the DC bus voltage is lower than the inverter's *Under voltage limit*, the inverter will switch off until the VDC once more goes above the under voltage limit.

Check whether the supply voltage fits the adjustable frequency drive. (See Technical data.) If the VDC remains under the under voltage limit, the inverter will trip after a fixed period of time. The time depends on the unit and is set at 1 - 3 sec. When the adjustable frequency drive is switched off a warning 8 (and warning 6) is displayed briefly.

NOTE: Voltage warning low (warning 6) will thus also be able to generate an alarm 8.

WARNING/ALARM 9: Inverter overload
Electronic thermal inverter protection indicates that the adjustable frequency drive is close to disconnecting due to overloading (output current too high for too long). The counter for electronic thermal inverter protection gives a warning at 98% and trips at 100% giving an alarm.

The adjustable frequency drive cannot be reset until the counter is below 90%. Remove the overload condition to the drive.

WARNING/ALARM 10: Motor overloaded
According to the electronic thermal inverter protection the motor is too hot. In parameter 128 the user can select whether the VLT adjustable frequency
drive should emit a warning or an alarm when the counter reaches 100%. This fault is due to the motor being overloaded by more than 100% for too long.

Check that motor parameters 102-106 are set correctly.

WARNING/ALARM 11: Motor thermistor
The motor is too hot or the thermistor/thermistor connection is cut off. Parameter 128 *Motor thermal protection* allows a choice of whether the adjustable frequency drive is to give a warning or an alarm.

Check that the PTC thermistor has been correctly connected between terminal 18, 19, 27 or 29 (digital input) and terminal 50 (+10 V supply).

WARNING/ALARM 12: Current limit
The output current is greater than the value in parameter 221 Current Limit I_{LIM}.

The adjustable frequency drive will trip after a set period of time, as selected in parameter 409 *Trip delay over current.*

WARNING/ALARM 13: Over current
The inverter's peak current limit (approx. 200% of rated output current) has been exceeded. The warning will last for approximately 1-2 seconds, and the adjustable frequency drive will then trip and give an alarm.

Switch off the adjustable frequency drive and check that the motor shaft can be turned and that the motor size fits the adjustable frequency drive.

ALARM: 14: Ground fault
There is a discharge from the output phases to ground, either in the cable between the adjustable frequency drive and the motor, or in the motor.

Turn off the adjustable frequency drive and remove the ground fault.

ALARM: 15: Switch mode fault
Fault in switch mode power supply (internal supply).

Contact your Danfoss supplier

ALARM: 16: Short-circuit
There is a short-circuit on the motor terminals or in the motor.

Disconnect the AC line supply to the adjustable frequency drive and remove the short-circuit.

WARNING/ALARM 17: Serial communication timeout
There is no serial communication to the adjustable frequency drive.

The warning will only be active when parameter 514 *Bus time interval function* has been set to a value other than OFF. If parameter 514 *Bus time interval function* has been set to *Stop and trip* [5], it will first give a warning and then trip and issue an alarm. Parameter 513 *Bus time interval* could possibly be increased.

WARNING/ALARM 18: HPFB bus timeout
There is no serial communication to the adjustable frequency drive's communication option card.

The warning will only be active when parameter 804 *Bus time interval function* has been set to a value other than OFF. If parameter 804 *Bus time interval function* has been set to *Stop and trip,* it will first give a warning and then ramp down, trip, and issue an alarm. Parameter 803 *Bus time interval* could possibly be increased.

WARNING 33: Out of frequency range
This warning is active if the output frequency has reached *Output frequency low limit* (parameter 201) or *Output frequency high limit* (parameter 202).

If the VLT adjustable frequency drive is in a mode other than *Process regulation, closed loop* (parameter 100) the warning will be active in the display. If the VLT adjustable frequency drive is in a mode other than *Process regulation, closed loop* bit 008000 *Out of frequency range* in the extended status word will be active, but there will be no warning in the display.

WARNING/ALARM: 34: HPFB communication fault
This communication fault can only occur in Profibus versions of the drive.

Contact the factory on advise for this alarm.

ALARM 35: Inrush fault
This alarm appears when the adjustable frequency drive has been connected to the AC line supply too many times within I minute. This type of fault is seen when the power is cycled on and off to fast. Warning -- repeated power cycling may erase the EEPROM in the drive and render it inoperable.

WARNING/ALARM 36: Over temperature
If the temperature of the heat sink moves above 167^{O}F - 185^{O}F (75 - 85^{O}C), depending on the unit, the adjustable frequency drive gives a warning, and the motor continues to operate unchanged. If the If the temperature continues to rise, the switching frequency is reduced automatically.

See Temperature-dependent switching frequency.

If the temperature of the heat sink rises above 199 - 212 ^{O}F (92 - 100 ^{O}C), depending on the unit, the adjustable frequency drive will trip.

The temperature fault cannot be reset until the temperature of the heat sink has dropped to below 158 ^{O}F (70 ^{O}C). The tolerance is ֍9 ^{O}F (֍5 ^{O}C). The high temperature can be caused by the following:

- Ambient temperature too high
- Motor cable too long
- AC line voltage too high

ALARMS 37-45: Internal faults

No set procedure is available for correcting these faults -- recycle the power on the drive (with a 90 second pause between power off and power on) to reset the EEPROM and attempt a restart.

Call the factory for directions on repeated failures.

ALARM 37: Internal fault number 0
Communication fault between control card and BMC2.

ALARM 38: Internal fault number I
Flash EEPROM fault on control card.

ALARM 39: Internal fault number 2
RAM fault on control card.

ALARM 40: Internal fault number 3
Calibration constant error in EEPROM.

ALARM 41: Internal fault number 4
Data values error in EEPROM.

ALARM 42: Internal fault number 5
Fault in motor parameter database.

ALARM 43. Internal fault number 6
General power card fault.

ALARM 44: Internal fault number 7
Minimum software version of control card or BMC2.

ALARM 45: Internal fault number 8
I/0 fault (digital input/output, relay or analog input/output)

NOTE!

When restarting after an alarm 38-45, the VLT adjustable frequency drive will display an alarm 37. In parameter 615 the actual alarm code can be read.

ALARMS 50-56: AMT faults

ALARM 50: AMT not possible
One of the following three possibilities can occur:
- The calculated R_S value falls outside permitted limits.
- The motor current in at least one of the motor phases is too low.
- The motor in use is probably too small for AMT calculations to be performed.

ALARM 51: AMT Fault re. nameplate data
There is inconsistency in the registered motor data.

Check the motor data for the relevant setup.

ALARM 52: AMT faulty motor phase
The motor current in at least one of the motor phases is too low.

ALARM 53: AMT motor too small
The motor used is probably too small for the AMT calculations to be carried out.

ALARM 54: AMT incorrect motor
AMT cannot be performed on the motor being used.

ALARM 55: AMT timeout
The calculations are taking too long, possibly due to noise in the motor cables.

ALARM 56: AMT warning during AMT
An adjustable frequency drive warning is given while AMT is being performed.

WARNING 99: Locked
The control panel functions have been locked via parameter 018.

RECOMMENDED SPARE PARTS

CONVEYOR COMPONENTS

QTY	RMI PART #	DESCRIPTION	SALE PRICE
1	515-8006	LIMIT VALVE – COMPLETE	
1	515-8130	WAND FOR 515-8006	
1	513-8125	AIR CYLINDER – COMPLETE	
1	324-0404	FLOW CONTROLS	
1	699-8011	DELAY STATION – SPRING	
1	514-8120	PILOT VALVE DLB AIR PILOT – COMPLETE	
1	847-8013	SINGLE ARM DELAY STATION	
1	847-8014	DOUBLE ARM DELAY STATION	
1	514-8500	24VDC INTRINSICALLY SAFE VALVE	

AIR LINE REPAIR KIT

10’	373-3800	3/8” TUBING
1	346-0600	3/8” UNION
10’	372-1400	1/4” TUBING
1	344-0400	1/4” UNION

CARTS

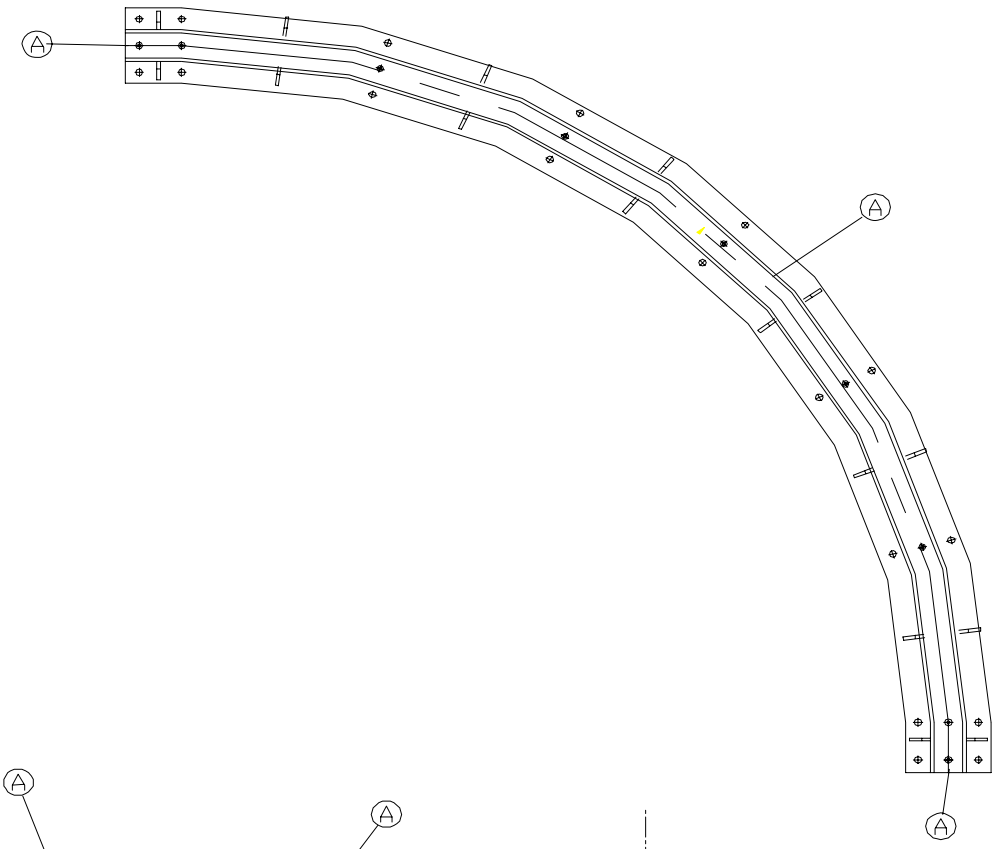
QTY	RMI PART #	DESCRIPTION	SALE PRICE
1	501-5221	SWIVEL CASTER	
1	502-5221	RIGID CASTER	
1	503-5221	ANTI BACK CASTER	
1	499-9025	CART PIN ON FLOOR	

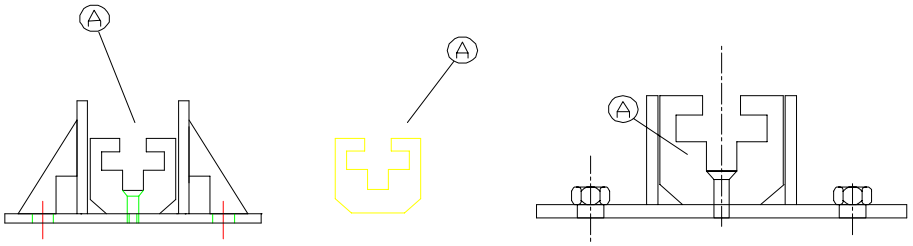
RECOMMENDED SPARE PARTS

DRIVE COMPONENTS

QTY	RMI PART #	DESCRIPTION	SALE PRICE
1	768-1100	MASTER LINK	
1	521-1009	BULL GEAR TOW CHAIN DRIVE SPROCKET	
1	057-1029	CHAIN GUIDE	
1	521-1010	PRIMARY DRIVE SPROCKET	
1	531-1225	2 HP EXP. PROOF MOTOR 230/480V 3 PHASE 60 HERTZ	
10	031-1011	2” 4 BOLT FLANGE BEARING	
1	031-1002	GEAR BOX. 60:1	
1	089-1039	TAKE-UP ROLLER 8” DIA.	
1	521-1046	SECONDARY DRIVE SPROCKET	
2	089-1040	BREAK OVER ROLLER, HARDENED	
1	089-1440	BREAK OVER ROLLER	
1	089-1041	6” IDLER ROLLER W/ BUSHING	
1	056-1030	UHMW FOR CHAIN GUIDE	
1	061-0214	PUSHER CYLINDER	
1	065-5002	PUSHER SPRING	
1	514-0421	PILOT VALVE DLB AIR PILOT – COMPLETE	

	RMI PART#	
A	706-7090	UHMW 2" X 2.125" X 8' {CUT TO FIT}





ON-FLOOR TURN

IN-FLOOR TURN

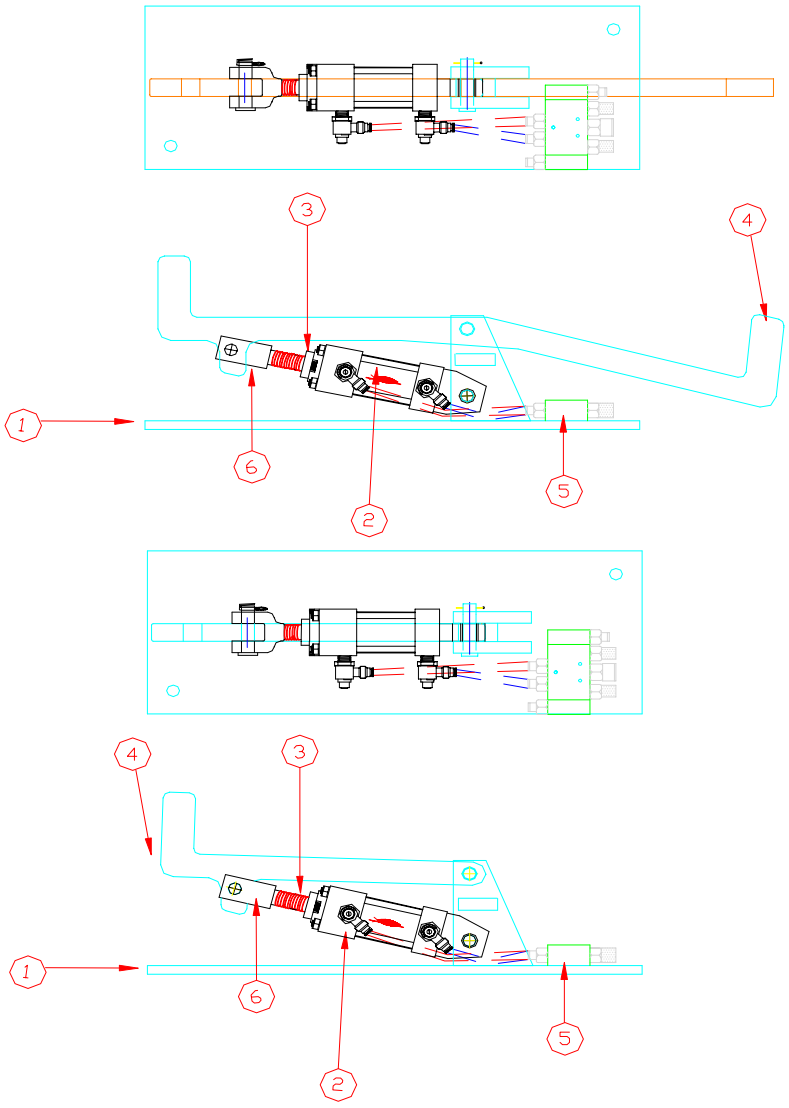
RSI, INCORPORATED

DESCRIPTION:

STANDARD 90 DEGREE TURN

SCALE: N.T.S.	DR. BY:	DATE: 1 / 1 / 05	PART NO.	SHEET NO.
	CK. BY:	DATE:		

MARKED	QTY.	DESCRIPTION	RMI NUMBER
1	1	DELAY STATION ASSEMBLY, PNEUMATIC	847-8013
2	1	AIR CYLINDER COMPLETE	513-8125
3	1	CYLINDER SPRING	699-8011
4	1	TOMAHAWK ARM	849-8013
5	1	PILOT VALVE W/FITTINGS	514-8120
6	1	CYLINDER ROD CLEVIS	843-8007



RSI, INCORPORATED

DESCRIPTION: STOP DELAY ASSEMBLY

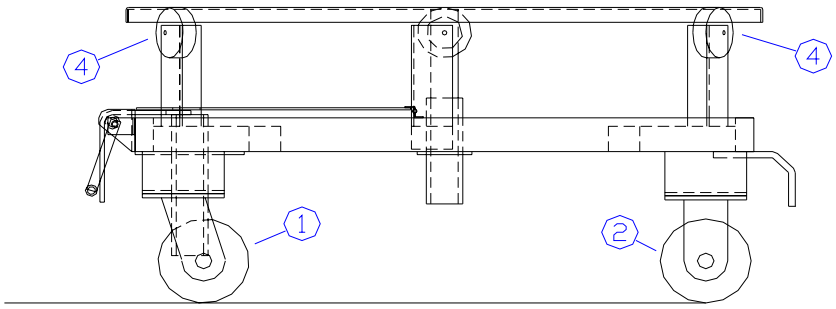
SCALE: N.T.S. DR. BY: _____ DATE: 1/6/05 CK. BY: _____ DATE: _____

PART NO.

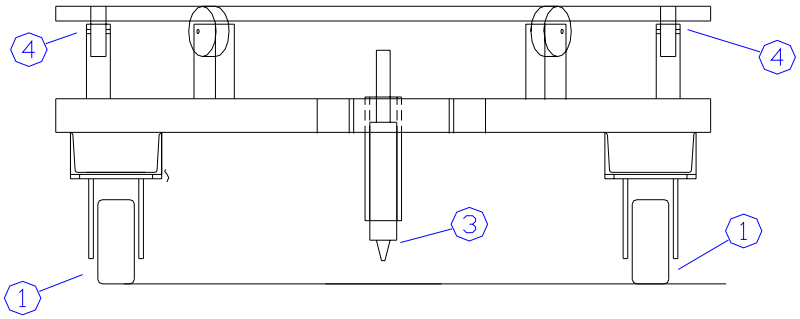
SHEET NO.

BILL OF MATERIALS

MARKED	QTY.	PART #	DESCRIPTION	REMARKS	QTY./EA.
1	2	501-5221	SWIVEL CASTERS		
2	1	502-5221	RIGID CASTER (NEAR SIDE)		
2	1	503-5221	ANTI-BACKUP CASTER (FAR SIDE)		
3	1	499-9025	RMI CART PIN		
4	4	502-3202	LAZY SUSAN WHEELS		



SIDE VIEW



FRONT VIEW

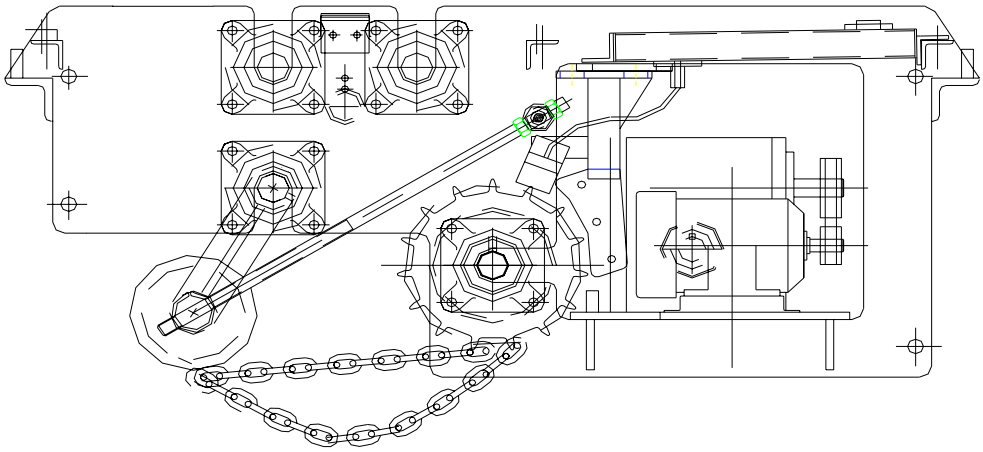
RSI, INCORPORATED

DESCRIPTION: STANDARD CART

SCALE: N.T.S. DR. BY: _____ DATE: 5-3-99
CK. BY: _____ DATE: _____

PART NO.

SHEET NO.



Side View

WHEN PROPERLY ADJUSTED, THE CHAIN SHOULD BE IN A STRAIGHT LINE FROM THE BULL GEAR AND THE 8" TAKE-UP ROLLER. THE CHAIN WILL FLUCTUATE AS CARTS ARE RELEASED FROM THEIR STATIONS.

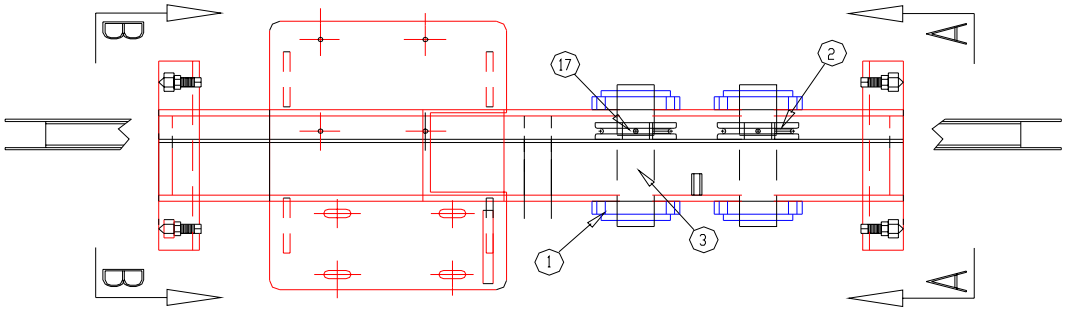
WHEN THERE IS CONTINUOUS SLACK IN THE CHAIN, THE CHAIN NEEDS TO BE READJUSTED. CONTINUOUS SLACK IS WHEN THERE IS SLACK AT ALL TIMES.

WHEN THE CHAIN IS TOO LOOSE, YOU WILL EXPERIENCE SLOW STEADY SURGES. WHEN THE CHAIN IS TOO TIGHT YOU WILL EXPERIENCE FAST ABRUPT SURGES. WHEN CHAIN IS TOO TIGHT THERE CAN BE PREMATURE WEAR ON THE SYSTEM

SINCE EVERY TOWLINE DIFFERS, THE CUSTOMER WILL NEED TO EXPERIMENT FOR THE BEST SETTINGS FOR THE TAKE-UP.

WHEN CHAIN IS SURGING ON MULTI DRIVE SYSTEMS ADJUST DRIVE BEHIND THE SURGE

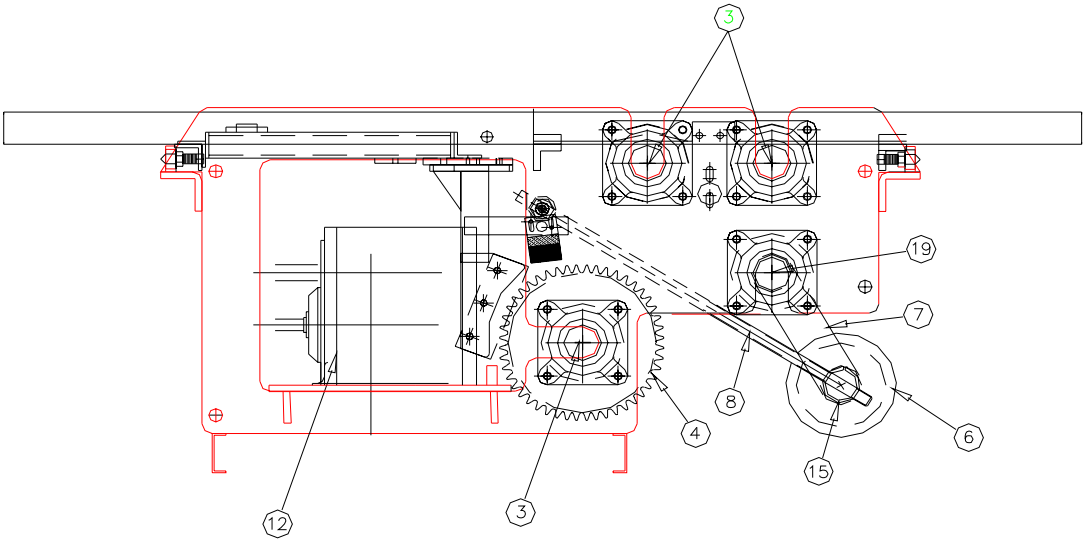
RSI, INCORPORATED			
DESCRIPTION: CHAIN ADJUSTMENT			
SCALE: N.T.S. DR. BY: _____ DATE: 1/10/05 CK. BY: _____ DATE: _____	PART NO.	SHEET NO.	



PLAN VIEW

SHEET 1 OF 5

RSI, INCORPORATED			
DESCRIPTION: DRIVE DETAILS			
SCALE: N.T.S.	DR. BY: _____ DATE: 5-3-99 CK. BY: _____ DATE: _____	PART NO.	SHEET NO.



SIDE VIEW

SHEET 2 OF 5

RSI, INCORPORATED

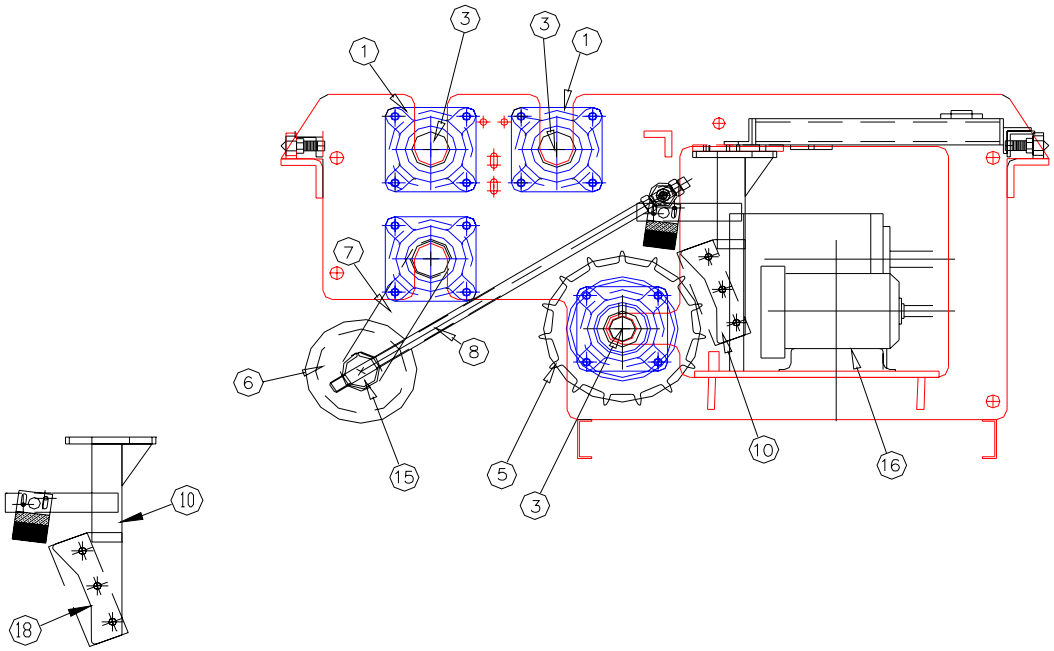
DESCRIPTION: DRIVE DETAILS

SCALE: N.T.S. DR. BY: _____ DATE: 5-3-99

CK. BY: _____ DATE: _____

PART NO.

SHEET NO.



SIDE VIEW

SHEET 3 OF 5

RSI, INCORPORATED

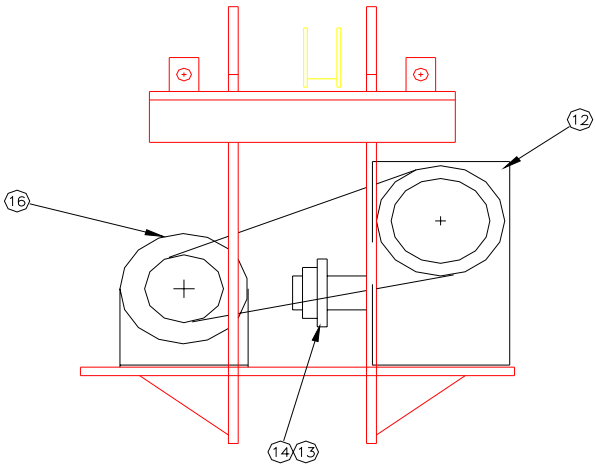
DESCRIPTION: DRIVE DETAILS

SCALE: N.T.S. DR. BY: _____ DATE: 5-3-99

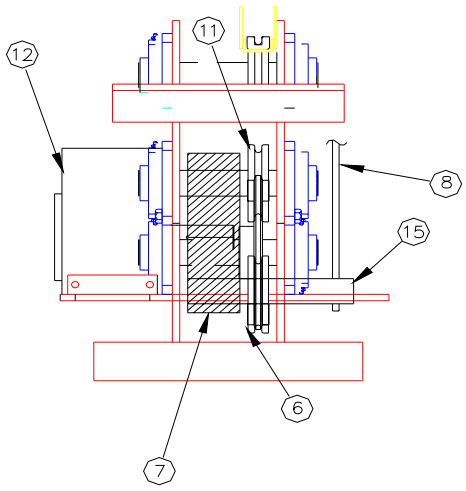
CK. BY: _____ DATE: _____

PART NO.

SHEET NO.



VIEW B-B



VIEW A-A

SHEET 4 OF 5

RSI, INCORPORATED

DESCRIPTION: DRIVE DETAILS

SCALE: N.T.S. DR. BY: _____ DATE: 5-3-99 CK. BY: _____ DATE: _____

PART NO.

SHEET NO.

MARKED	QTY.	DESCRIPTION	RMI PART NUMBER
1	10	4 BOLT FLANGE BEARING	031-1011
2	1	6" BREAKOVER ROLLER	089-1440
3	3	2" ROLLER SHAFT W/KEYWAY	087-1036
4	1	MAIN DRIVE SPROCKET	521-1010
5	1	BULLGEAR (TOWCHAIN DRIVE SPROCKET)	521-1009
6	1	8" TAKE UP ROLLER W/BUSHING	089-1039
7	1	SWING ARM W/BUSHING	029-1037
8	1	TAKE UP ROD ASS'Y (COMPLETE)	087-1101
9			
10	1	COMPLETE CHAIN GUIDE	057-1029
11	1	6" IDLER ROLLER W/BUSHING	089-1041
12	1	GEAR BOX	531-1002
13	1	DRIVE ROLLER CHAIN	084-1017
14	2	SECONDARY DRIVE SPROCKET	521-1046
15	1	SWING ARM TAKE UP SHAFT	088-1152
16	1	2 HP EXPLOSION PROOF MOTOR	531-1225
17	1	6" HARDENED BREAKOVER ROLLER	089-1040
18	2	UHMW GUIDE	056-1030
19	1	ROLLER SHAFT	089-1035
20			

SHEET 5 OF 5

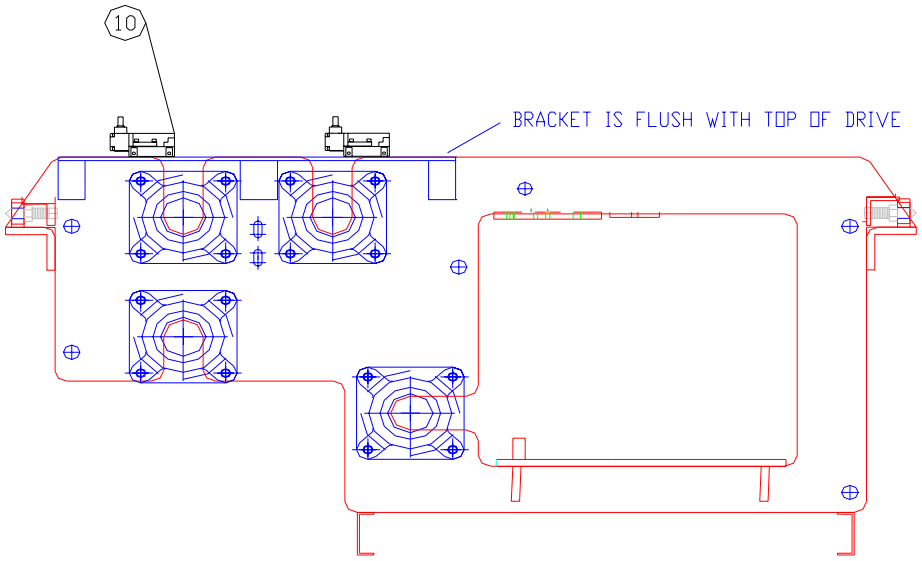
RSI, INCORPORATED

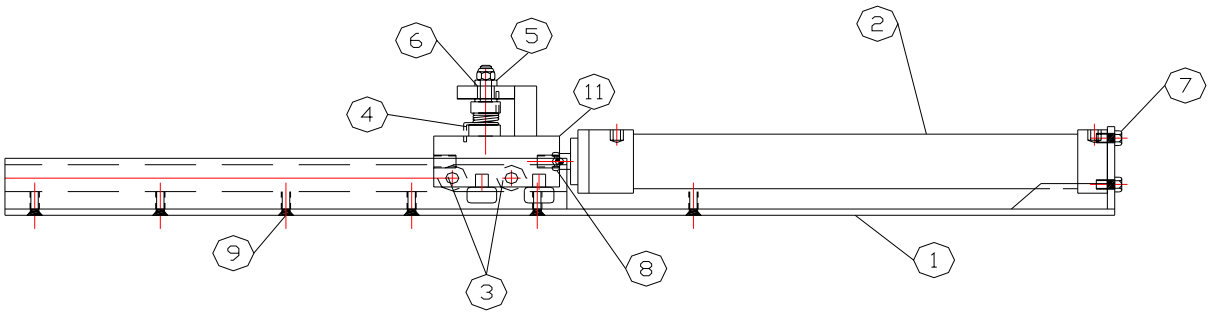
DESCRIPTION: DRIVE DETAILS

SCALE: N.T.S. DR. BY: _____ DATE: 5-3-99 CK. BY: _____ DATE: _____

PART NO. | SHEET NO.

MK' D.	RMI-NO.	DESCRIPTION	QTY.
1	067-5002	"RHODES" CARRAGE PUSHER ASSEMBLY	1
2	061-2014	AIR CYLINDER 2"ø BORE	1
3	060-1500	CAM ROLL 1"ø STUD MOUNT	6
4	007-9501	TORSION SPRING	1
5	521-3891	BRONZE BUSHING 3/8"I.D.X9/16"O.D.	2
6	626-1220	NYLOK NUT 1/2-20UNC	1
7	615-5162	HEX BOLT 5/16-24UNF W/L.W.	4
8	629-7162	JAM NUT 7/16-20UNF	1
9	684-1420	SCREW FL. HD. 1/4-20UNC	10
10	515-8006	LIMIT VALVE	2
11	068-5002	PUSHER TRUCK	2





RSI, INCORPORATED

DESCRIPTION: RMI DRIVE PUSHER

SCALE: N.T.S. DR. BY: _____ DATE: 1/6/05 PART NO. SHEET NO.

CK. BY: _____ DATE: _____

MAINTENANCE RECORDS

DATE PREFORMED	ACTION	BY
DATE PREFORMED	ACTION	BY